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POWER

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Little Efforts

IT IS what one actually does that counts, that makes him what he is, that shapes his surroundings and his circumstances to his liking and advantage.

But to do anything requires an effort.

And rather than to exert the effort many a worth-while thing remains undone.

There are lots of men with fine ideas who are fully capable of realizing them if they would but make the effort.

But what I have in mind are not the larger achievements that win reputation and preferment, but the little things that in the aggregate make up one's life and job and habits and character.

It would be a good thing to regulate his watch, to sharpen his knife, to mend his fence, to go over this or that machine or piece of apparatus, but it requires an effort.

It would be nice to read a book or article that one has heard discussed, to go to a meeting of one's fraternal or professional society, to send a greeting to a friend, to order those supplies away inside of the time that they will be needed. But inertia is so hard to overcome.

It would be worth-while to have an electrical or steam connection somewhere, to make a much-used valve or other control more accessible, to ease up a door that binds, a drawer that sticks, a hinge or joint that creaks, but one goes along using in the aggregate more time and energy than it would take to fix them.

And yet, as I started by saying, it is the habit of doing these things, instead of intending to do them or wishing that they were done, or not caring anyway, that makes one man orderly, ready, smooth-running and sitting pretty and another cluttered and inefficient.

F. R. Low

POWER *Stands for . . .*

1. **Making Power When It Should Be Made**
2. **Buying Power When It Should Be Bought**
3. **Cheaper Power Through Modern Equipment**
4. **Easier Financing of Equipment Purchases**
5. **Better Use of Byproduct Heat and Power**
6. **Operating Methods That Save Money**
7. **Less Waste in Transmission and Application**

Oil and Gas Power Conference

FOR the last two years the Oil and Gas Power Division of the American Society of Mechanical Engineers has held national conferences at the Pennsylvania State College. These meetings of men eminent in the Diesel-engine field have permitted the exchange of much valuable information and have been the means whereby several needed investigations could be put under way. Among these is the standardization of Diesel fuel oil. The committee, composed of Navy men, engine builders and refinery representatives, have made enough progress to justify a report, which will be presented at the next conference to be held from June twenty-four to twenty-eight at State College, Pennsylvania.

As has been outlined in the news pages of previous numbers, several valuable papers will be presented. This year the social side of the conference will be given more emphasis than heretofore.

Those who are interested in Diesel application will find the conference well worth attending.

The Citizen and the Law

INDIFFERENCE to the law on the part of the public is now receiving most of the blame for the current wave of crime. Grave danger to the nation is freely predicted by men in the public eye, unless the citizens return to a rigid adherence to the latter of the law. Nation-wide radio broadcasts are now being used to bring this idea home to all.

Of course it is a fact that successful law enforcement and respect for law comes back, in the final analysis, to the attitude of the individual voters. It is well said that by the power of the vote they can end the reign of lawlessness through the election of officials who will administer the laws effectively.

Human nature, however, is such that this plea holds but little prospect of acceptance. The man in the street sees his leaders primarily concerned with the enforcement or non-enforcement of but one law—the prohibition law. It is but natural, therefore, that his attention should be concentrated on this one to the exclusion of others.

There seems to be but little chance of arousing public interest in the equal enforcement of all laws. If that is true, the question resolves into one of what laws should be rigidly enforced. Safety of life and property, integrity of the home, fair economic opportunity for all are of more importance to the people than anything else. If they give support at the polls only to those candidates with the will and capability to enforce laws protecting those rights, conditions will be greatly improved. When this main battlefield of law enforcement is won, it will be time enough to turn attention to other laws, which, however popular they may be with certain classes, affect but little the true welfare of the people.

How, may be asked, does this affect the power field? Think but a moment of the laws and ordinances on the books referring to safety in plants, abatement of smoke nuisances, and other factors concerned in the health and life of both the makers and consumers of power. Each power engineer can help to advance the cause of proper enforcement of the law by doing his part in the election of officials who will make these safety laws and ordinances effective.

Laying Up Heating Boilers

AS THOUSANDS of heating boilers are laid up each June for the summer, a question was asked in a recent number as to the best method. Several replies appear in this issue. Unfortunately, space limitations prevent the publication of the entire seventy-one answers received.

In going over the correspondence, one is impressed by the lack of uniformity in instructions given by the many engineers. Apparently, the question is debatable among our readers. Neither does geographical location seem to influence the procedure followed by the individual.

It would seem that there should be agreement on either a filled or an empty boiler. But of the readers who mentioned this item, eighteen recommended that the boiler be left full of water, while fifty-two declared in favor of an empty boiler, of which number twenty-five recommended that oil be added to the water before emptying in order to coat the interior shell and the tubes.

Open firedoors were preferred by nine, while forty-two closed them. The open and closed damper drew about the same relative number of votes.

The old remedy, unslaked lime, retained its popularity with twenty-one readers, and twelve recommended a light fire to dry the boiler and furnace completely.

One engineer related that he had tried both methods, but could find no advantage in either.

The real problem occurs in a damp location. Here an empty boiler may corrode, and it is preferable to carry it filled with water. To avoid rust on the outer surfaces, a light fire should be kindled occasionally and with all soot removed, dampness will not occur in excessive amounts.

Avoid Large Temperature Contrasts in Air Conditioning

WITH the approach of hot weather, operators of air conditioning equipment, installed for the purpose of increasing comfort conditions, are confronted with the problem of determining the best temperature and humidity to maintain. There is a tendency to maintain temperatures that are too low. This is not only expensive, but unnecessary and undesirable. A condition of 85 deg. and 40 per cent relative humidity would be unbearable during the heating season, but when the outside temperature is 95 and the relative humidity is 50 per cent, this condition would be gratefully comforting.

Some engineers endeavor to maintain a definite effective inside temperature regardless of outside condition, while others aim to keep an inside temperature 10 to 20 deg. less than that outside. The object should be a reasonable contrast between outside and inside conditions.

It has been suggested that the inside conditions should be maintained at an effective temperature midway between the outside conditions and an effective temperature at which body heat is thrown off with the least discomfort, or about 66 deg. effective temperature.

With such a program the contrast would lessen as cooler weather approaches and the possible saving in refrigeration is evident.

Bolts for High Steam Pressures and Temperatures

ONE of the problems incident to the use of higher steam pressures and temperatures is that of providing suitable bolts for pipe and other flanges. These bolts will be put under certain stresses by screwing up the nuts, in order to hold the joints tight. Large bolts might be considered to lower the unit stress, but flanges are usually of such a form that the size of bolt that can be used practically is limited. Hence, flange bolts must be under high unit stress if the joint is to be held tight under operating conditions.

High pressure alone presents no serious difficulty to the designer of flanges, and bolt materials have been available for such service for some time. When high temperatures—that is, temperatures over seven hundred and fifty degrees Fahrenheit—are to be used, another problem is presented. Steels appear to develop the phenomenon of "creep" under these higher temperatures. "Creep" is the name given to the continued extension of steels under stress at high temperatures. Under these conditions bolts would continue to elongate under load until either the load was relieved by the elongation of the bolt or its cross-section became so diminished due to the stretching that the bolt would fail. In either case the flange would be no longer tight.

Special alloy-steel bolts are available for this service, and many of these are in satisfactory use. The cost of such alloys and the care that must be taken in tightening them in place raise the question whether some other type of bolt can be developed.

Long bolts might be used which project some distance beyond the flanges and with air-ventilated collars between the washer under the nut and the flange. The strain would be distributed over the whole bolt, and conduction would maintain the part in the flange at a lower temperature than the flange itself, particularly if an insulating collar were also used between the flange material and the bolt. These should be useful in some locations.

Another plan that might be applied around turbines is the use of hollow bolts. These could be provided with pipe connections at each end through which a portion of the condensate could be circulated to keep the bolts within certain temperature limits. This condensate could be returned to the feed heating system and no heat would be lost. In fact, in a turbine casing, this heating of condensate could follow the regenerative system.

These suggestions involve expensive materials and complicated design, but would seem to be workable particularly if steam temperatures of one thousand degrees Fahrenheit or higher are used.

Leave a Power Margin to Work With

IN BUILDING a new industrial power plant or revamping an old one there is a tendency to work for an exact balance between power and process steam. This may be unnecessary and unwise. As has been pointed out before, an unbalance on the side of excess byproduct-power capacity involves no loss of fuel whatever. True, this unbalance makes it necessary to pass some boiler steam to process through reducing valves rather than through the engines or turbines, but the boiler load is the same as if all the process steam passed through the prime movers.

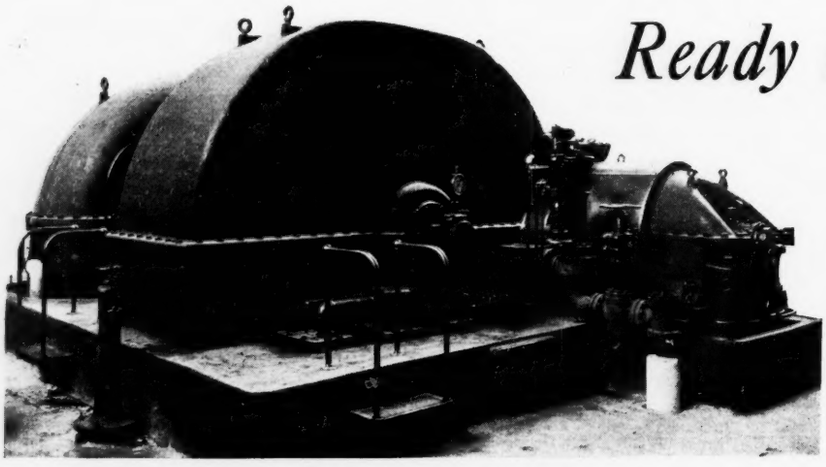
A plant laid out for exact balance has no margin for future expansion that may increase the power load faster than the process steam load—and the tendency is generally in that direction.

Of course, fuel cost is not the only cost, and the provision of excess thermal efficiency demands extra expenditure in the shape of higher-pressure boilers, more efficient generating units and, perhaps, electrical auxiliary drives. One should not carry these beyond the point where the added fixed charges are warranted as an insurance premium against future changes in power and steam demands. If first cost must be kept down, it is better to save money on the auxiliaries than to adopt too low a boiler pressure, as it is easier to modernize the auxiliaries later than to provide for increase in the boiler pressure.

The table published in the May 28 issue showed considerable activity in the construction of industrial plants for pressures in the range from 300 to 500 lb. Many of the plants adopting such pressures are thereby placing themselves in a position to generate practically all power as a byproduct now and in the future.

Howard Bend Pumping Station

Ready to Serve St. Louis



Low-head pump of 120 million gallons daily capacity, showing casing for 122-in. diameter gear

ONE OF THE LATEST AND MOST MODERN PUMPING STATIONS *in the country using 670-deg. steam, forced-draft stokers, preheated air, compound turbines to drive high-head centrifugal pumps of great size and other features not common to pumping stations. Factors kept foremost in design were reliability and the flexibility necessary to insure service.*

THE initial installation at Howard Bend Pumping Station, on the Missouri River, one of the most modern purification and pumping plants in the country, is now ready for operation, and, in conjunction with the Chain of Rocks Station on the Mississippi River, will supply St. Louis and eventually the county, including the suburbs on the western boundary of the city. A location on the Missouri River thirteen miles west of the city limits was selected.

The pumping station, with which we are chiefly interested in this story, has been built to accommodate all equipment necessary for an ultimate capacity of 250 m.g.d., but for a number of years to come it will not be called upon to deliver more water than an average of 55 m.g.d.

This new plant contains a number of features not common to water works. First, centrifugal pumps of record size have been used. The high-pressure units are unusual in that two single-stage pumps in series are geared to a cross-compound turbine. Steam conditions are higher than the normal in water works, a boiler pressure of 325 lb. and superheat of 245 deg. F. giving a final steam temperature approximating 670 deg. Forced-draft chain grates in large furnaces, side-wall cooling, and the use of air preheaters are new departures for pumping stations. Treated water for boiler-feed makeup is softened before it is passed to evaporators. Steam is bled for process and heating from turbine prime movers. The water-works type of condenser has been abandoned for power condensers. Charging water in the process of purification with carbon dioxide to prevent solid deposits in the filter beds is common practice, but drawing this CO_2 from the boiler flue gas is individual to the Howard Bend Station.

Reliability and flexibility were the two factors kept in the foreground throughout the entire design. Reserve capacities were essential, as the station is isolated and must depend on its own resources. This reserve is found in the boiler room, in the pumps, and for electrical generation a gasoline-engine-driven generator backs up two turbine-generators and supplies the power for starting cold. There are loop headers and duplicate pipe lines, and although both forced and induced draft are provided, a stack has been built high enough to meet the requirements with natural draft.

Details of equipment, anticipated performances and initial costs are given in the accompanying table. From the high-head pumping units an average annual duty, based on weighted averages of loads, of 163.6 ft.-lb. per B.t.u. is anticipated. The best duty guaranteed, at 50 m.g.d. and 336-ft. head, is 168 ft.-lb. per B.t.u. Duties for the low-head pumps naturally are lower, as indicated in the table. Cost of pumping reduced to an electrical basis, has been placed at 0.67c. per kilowatt-hour.

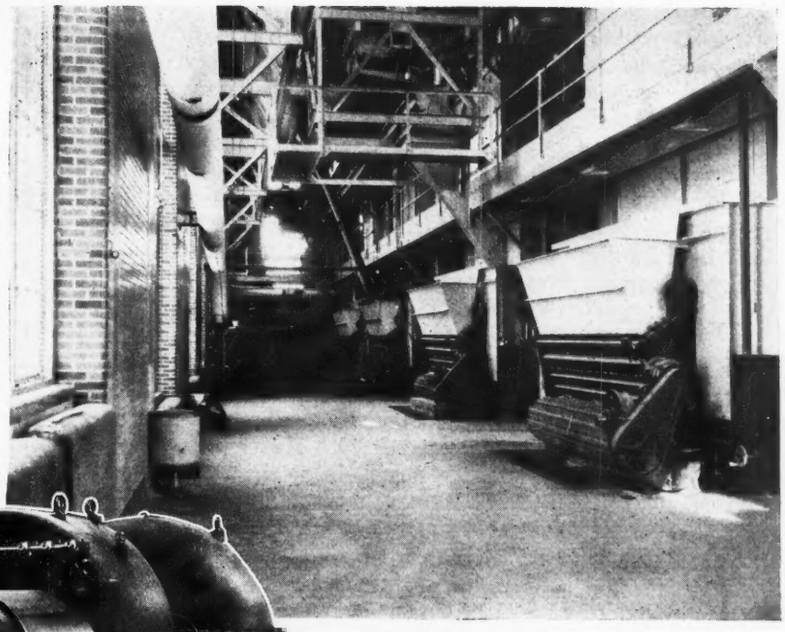
MODERN WATER WORKS BOILER ROOM

The boiler room is 180 ft. long, 60 ft. wide and 80 ft. high over-all, to provide for three floor levels.

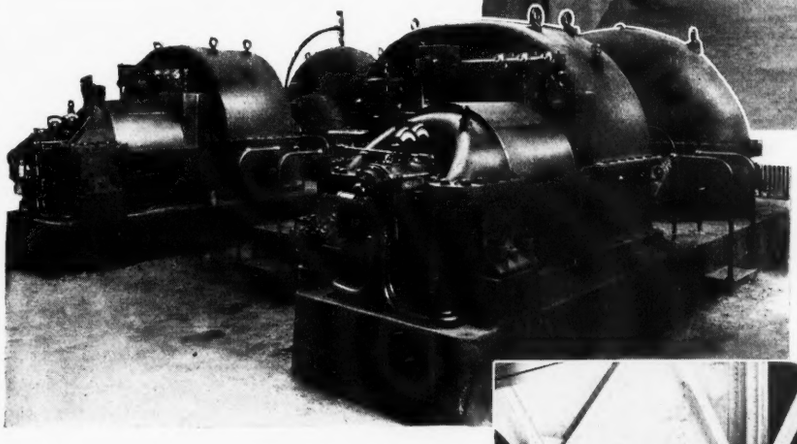
Four 6,520-sq.ft. cross-drum water-tube boilers have been installed. The front water leg or box header is 14 ft. 6 in. above the floor line to provide a furnace volume of 2,515 cu.ft., or 0.4 cu.ft. per square foot of heating surface.

Motor-driven, forced-draft chain grates were selected, as in previous practice the department had found this type of stoker to be more flexible and to give economies slightly higher than the natural-draft stoker.

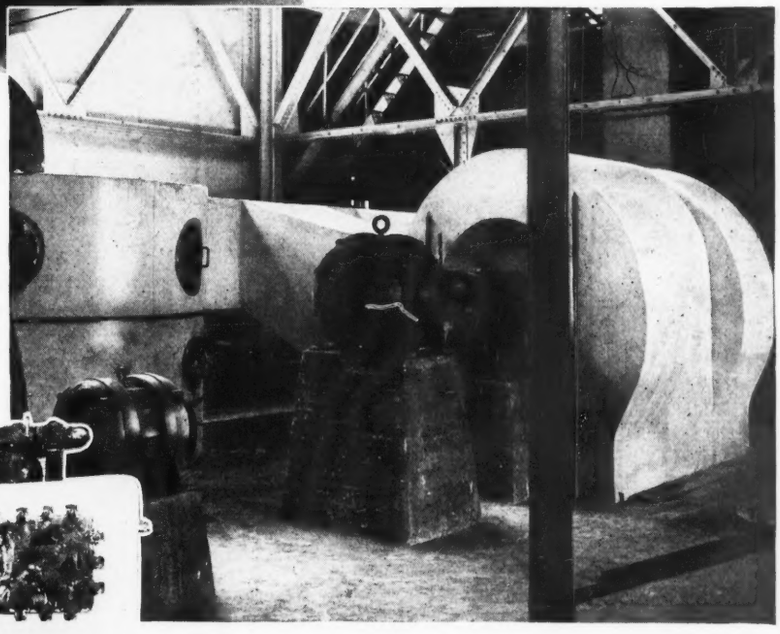
Combination superheaters have been used to maintain steam temperatures more nearly constant. The convection superheater is over the tubes, and the radiant superheater, composed of seamless forged-steel elements presenting a flat surface to the fire, has been placed in the rear wall of the furnace, where it is readily accessible.



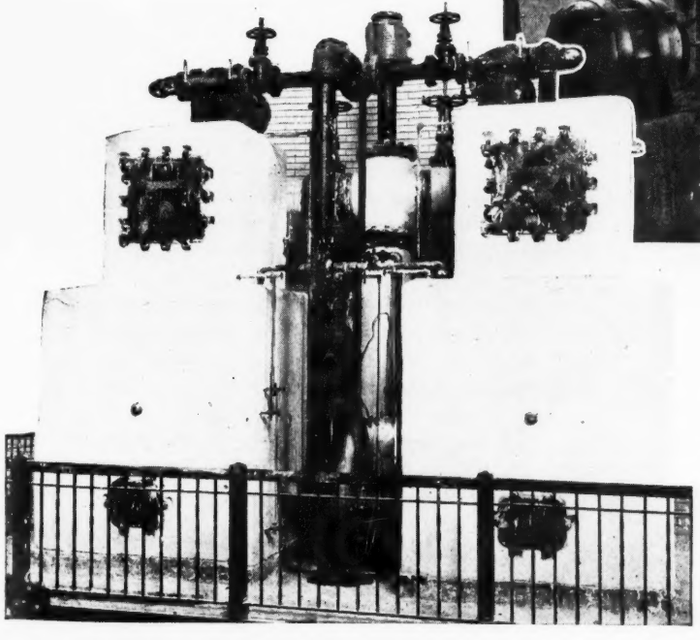
Right—The boilers are equipped with motor-driven chain-grate stokers and convection and radiant superheaters. They will operate at 325 lb. pressure and 670 deg. total temperature



Left—Two 60-m.g.d. turbine-driven low-head pumps. The plant contains also one 120-m.g.d. low-head pump and two 60-m.g.d. high-head pumps with space for additional units



Right *— Induced draft fan and air preheater*



Left—These two deaerating heaters, with large water-storage compartments, receive all drains, condensate returns and the necessary makeup water

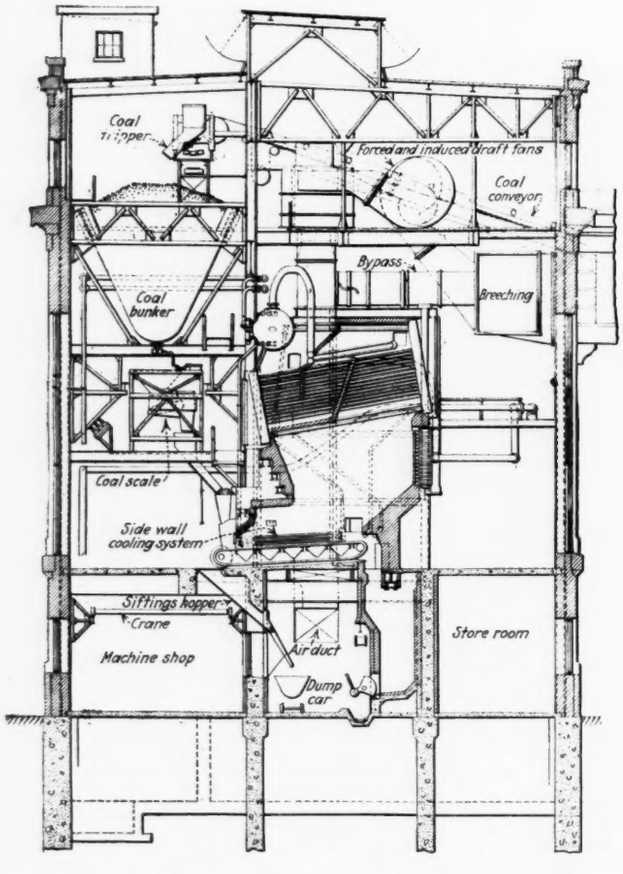
When operating at 200 per cent rating, each of the present boilers will deliver 39,000 lb. of steam per hour to the header at 325 lb. pressure and 245 deg. superheat.

Two of the boilers have been equipped with air preheaters of the regenerative type. It is probable that the other two will be similarly equipped, but in any event the duct system has been so arranged that air at normal temperature or preheated may be supplied to any boiler by any one of the four 24,000-cu.ft. per min. forced-draft fans. Induced-draft fans of 27,500 cu.ft. per min. capacity serve the two boilers equipped with air heaters.

Flue CO_2 Used in Water Purification

One of the new departures is the use of the CO_2 in the flue gases in the water-purification process, chiefly to prevent solid deposits of lime in the filter. The gases are drawn from the base of the stack by a Hytor pump and are cleaned in wet and dry scrubbers of sheet-steel construction lined with lead to avoid corrosion. These are located in the foundation supporting the stack. To insure equal distribution of the carbon dioxide through the water, it is introduced through two headers fitted with perforated laterals from which the gas bubbles up and is absorbed while passing through fifteen feet of water.

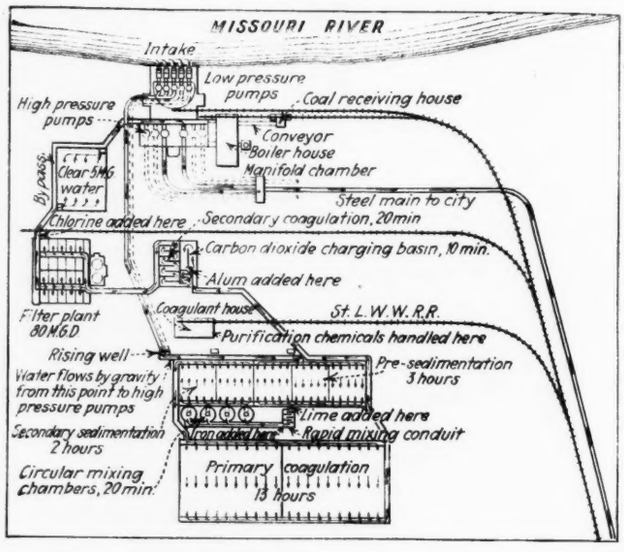
Meters and gages for the four boilers and controls for the auxiliaries are grouped on a control board in the firing aisle. Steam pressures and temperatures are indicated. A steam-flow air-flow meter shows the load on each boiler. Push-button controls are provided for starting and stopping the fans, and automatic control is provided for the stoker motors. Besides regulating the stoker speed, an automatic combustion control system varies the draft and damper settings to suit the load. Feed-water regulators maintain uniform water level in the boilers.



Four 6,520-sq.ft., cross-drum boilers have been installed

Belt Conveyors Handle Coal

Coal for the plant is delivered in hopper-bottomed cars to a receiving house about 200 ft. distant from the boiler room. The coal is emptied into a truck hopper and by a cross-conveyor transferred to a motor-driven ring-type crusher which reduces it to $\frac{3}{4}$-in. size. It is then conveyed to the bunkers. All conveying equipment is motor driven and interlocked electrically. The bunker, which is



Diagrammatic layout of Howard Bend purification and pumping plant

of 900 tons capacity, is sealed off from other parts of the boiler room. Delivery to the stokers is made by two electrically propelled weigh larries, each of 2,000-lb. capacity and equipped with automatic recording scales.

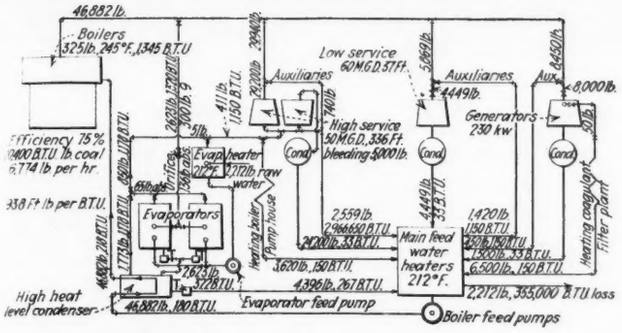
Coal in addition to the bunker capacity will be stored on the ground in small piles and reclaimed by means of a crawler type locomotive crane.

Feed Water Softened and Evaporated

All equipment for purifying, heating and pumping the feed water is located in the low-pressure pump pit. Two deaërating heaters with large water-storage compartments receive all drains, condensate, returns and the necessary makeup water. Exhaust steam from the auxiliary turbines or bleeder connections to the main turbines driving the high-head pumps, heat the feed water to 212 deg. F. for delivery to the boilers free of oxygen by any one of three centrifugal feed pumps.

All returns to the heaters are practically pure distilled water free of oil, but the addition of makeup containing about 16 grains of solids per gallon would be sufficient to build up an appreciable concentration in the boilers, so it was decided to install evaporators of the single-effect, high-heat-level type. To prevent hard scale formation in the coils, the makeup is first treated in a zeolite softener.

Makeup water from the softener is heated and deaërated in a small open heater using exhaust steam and is then pumped into the evaporator shell. Normally, the heat for the submerged evaporating coils is supplied by



Heat balance diagram based on pumping 50 m.g.d.

steam at 50-lb. pressure bled from the turbines driving the generating units, but this supply may be supplemented or replaced by live steam reduced through an orifice plate.

Piping Designed for 750-Degree Steam

To withstand the high steam pressure and temperature, extra strong piping, built for the 400 lb. 750 deg. standard, has been used, the larger sizes being double random length, seamless drawn steel tubing. All valves and fittings $\frac{3}{4}$ in. diameter and above are flanged and the valve bonnets are bolted. Valves and fittings up to 2 in. diameter are of forged steel and the larger fittings and valve bodies are of chrome nickel cast steel. Van Stone joints have been used on pipes of $2\frac{1}{2}$ in. diameter and larger, the pipe being flared out and upset over the flange, so that the joints have been made between the ends of the pipe, and the flanges fitting loose on the pipes are pulled together by means of chrome nickel steel studs.

The main steam header is a loop carried through the entire plant and closed in the low-pressure pit and boiler house. In each pit is a separate header so that steam may be taken from either end of the boiler header.

Centrifugal Pumping Units of Record Size

Both the high- and the low-pressure buildings are combined to form a T-shaped structure, galleries being provided on the edges of both pits, and in the high-pressure building a bridge spans the pit to give direct access from the main entrance to the low-pressure building. For high-head pumping the pit is large enough to accommodate six 40 m.g.d. turbine-driven pumps, two of which have been installed with a maximum capacity of 60 m.g.d. each against a head of 360 ft. These pumps are probably the largest in the country operating against a head slightly exceeding 150 lb. The unit consists of two single-stage pumps in series arranged in tandem on a common shaft driven from the same gear by a pinion on either side, one of the pinions receiving its energy from the high-pressure element of a cross-compound steam turbine and the other pinion from the low-pressure element of the turbine. By reducing the length of the turbine shaft this double-pinion drive tends to lessen the thrust and wear, and the separation of the turbine into two distinct casings gives slightly better economy. From a bleeder connection at the ninth stage of the turbine steam is extracted at about five pounds pressure for heating feed water for the building. The horsepower of each unit running at full load is about 6,000, and the best guaranteed duty at 50 m.g.d. and 336 ft. head is 168 ft.-lb. per B.t.u.

Condensers serving these turbines are of the power-plant type with steam-jet air ejectors and dual-drive condensate pumps. Circulating-water pumps are driven from the main pump shafts. For this new plant use of the old water-works type of condenser was abandoned because of the tendency of leaves and débris getting past the screen choking the tubes and the destructive action of the sand carried in the raw water.

All large suction and discharge valves in this pit and also in the low-pressure pit are operated by hydraulic cylinders. In the discharge line of each high-pressure pump a new type of automatic check valve has been installed that will eliminate water hammer. It is of the plug type that gives an opening of full pipe area. Opening and closing is effected through rotation of the plug by a hydraulic cylinder operated in turn by a pilot valve depending upon the velocity of the water in the discharge line from the pump.

In the low-pressure pit, which is 90 ft. in diameter and 45 ft. deep, are three turbine-driven single-stage centrifugal pumps, the largest having a capacity of 80 to 120 m.g.d. and the two smaller units a capacity of 40 to 60 m.g.d. each. Space has been provided for two additional units of the larger size. The gear serving the 120-m.g.d. pump, having a diameter of 122 in. and a 23-in. face, is the largest ever used for land service. The gear ratio is 26.57 to 1.

Gasoline Engine Stand-by Backs Turbine Generators

To supply the power for the auxiliaries in the pumping and purification plants and the lighting for the entire works, two turbine generators of 300-kw. capacity at 80 per cent power factor have been installed between the two pumping sections of the plant. The turbines are of the extraction type and at full load it will be possible to bleed 9,000 lb. of steam at 50 lb. pressure for process heating in the coagulant house and for the evaporators supplying pure feed water makeup.

Emergency power for auxiliaries and lighting is supplied by a 90-kw. generator driven by a six-cylinder high-speed gasoline engine, operating at 1,200 r.p.m.

Centrifugal Separators and Filters Purify Oil

One of the interesting features of the station is the oil purification system using both centrifugal purifiers and filters. Each pumping unit has its individual filter arranged on the partial filtration plan through which about 10 per cent of the unit's oil supply is passing continuously. About once a week the entire oil supply of a unit is drained to a dirty-oil tank and after passing through the centrifugal purifier is pumped to an overhead clean-oil tank to be available for the first unit requiring clean oil.

Maintaining the Heat Balance

With the flexibility obtained by using auxiliaries driven by either of two sources, such as the steam- and hydraulic-driven condensate pumps, the motor- and steam-turbine-driven boiler-feed pumps, steam bled at 5-lb. pressure from the high-head pumping units and steam bled at 50 lb. pressure from the generating units, the maintenance of a good heat balance is assured.

The entire plant was designed and the construction supervised by the Water Division Engineers of the city. Up to the time all contracts were awarded, Leonard A. Day was division engineer and H. Clay Henning, assistant division engineer. Mr. Day now holds the office of water commissioner.

DATA AND COSTS OF MECHANICAL EQUIPMENT
HOWARD BEND PUMPING STATION

Boilers and Superheaters

Boilers, cross-drum, water-tube, 4	Heine
Surface, sq.ft.	6,521
Safe working pressure, lb. gage	375
Operating pressure, lb. gage	325
Superheat, deg. F.	245
Total steam temperature, deg. F.	674
Setting height, bottom front water leg to floor, ft.	14.5
Side wall cooling	3 rows 3½-in. tubes
Furnace volume, cu.ft.	2,515
Steam purifiers, Hagan centrifugal	Hagan Corp.
Combustion control	Carrick Eng. Co.
Soot blowers	Diamond Power Spec. Corp.
Water columns and illuminators	Reliance Gauge Column Co.
Breechings and ducts	Hamler Boiler & Tank Co.
Chimney, concrete, brick veneer, 275 ft. high 13 ft. diam.	John Boland Constr. Co.
Feed-water regulators, Copes,	Northern Equipment Co.
Blowoff valves. Yarway tandem type	Yarnall-Waring Co.
Safety valves	Ashton Valve Co.
Piping	Midwest Piping & Supply Co.
Insulation	Philip Carey Co.
Superheaters, Foster convection and radiant	Foster-Wheeler Corp.
Cost of 4 boilers, superheaters, soot blowers, etc.	$106,000
Cost per 10 sq.ft. of ht. surf. including erection	40.65

Air Preheaters

Air preheaters, Ljungstrom, two	Air Preheater Corp.
Cost of two preheaters	$13,305

Stokers

Stokers, 4 Green forced-draft chain grates	Combustion Eng. Corp.
Active grate area, 13 ft. 6 in. by 12 ft. wide, sq.ft.	162.
Drive, 2-hp. Louis Allis variable-delivery motor, 440-v. 3-ph. 60-cycle.	
Cost of four stokers	$29,995

Forced and Induced-Draft Fans

Manufacturer	B. F. Sturtevant Co.
Forced draft	4 double-wheel, double-inlet, motor-driven.
Capacity each	24,000 c.f.m., 110 deg. air, 3 in. static head.
Speed, r.p.m.	900.
Induced draft	2 Motor-driven.
Capacity each	27,500 c.f.m., 285 deg. gas, 2.3-in. st.hd.
Speed, r.p.m.	575.
Cost of 4 forced and 2 induced-draft fans	$12,554.

Summary Boiler Costs

No.	Item	Number	Total	Cost Per Sq.Ft.Surf.
1	Boilers, superheaters	4	$106,000	$4.065
2	Stokers	4	29,995	1.150
3	Settings	4	43,209	1,655
4	Air preheaters	2	13,305	1.020
5	Forced-draft fans	4	4,854	0.186
6	Induced-draft fans	2	7,700	0.590
7	Breeching and duct work		18,000	0.690
Total per sq. ft. surface for items 1 + 2 + 3 + 4 + 5 + 6 +				$9.356
Total per 10 sq.ft. surface for items 1 + 2 + 3 + 5 + 7				$7.746

Cranes

Manufacturer	Milwaukee Electric Crane & Mfg. Co.
High-pressure pit	One 20-ton, 75-ft. span, 45-ft. lift.
Low-pressure pit	One 20-ton, 90-ft. span, 65-ft lift.
Cost of the two 20-ton cranes	$23,450

High-Head Pumping Units

Manufacturer	De Laval Steam Turbine Co.
Units	Two 30-60 m.g.d., 316-360 ft. hd., compound steam turbine geared to two single-stage pumps in series.
Brake horsepower, max.	4,460
Maximum speed	h.p. turbine, 4,500 r.p.m.; l.p. turbine, 3,460 r.p.m.; pumps, 596 r.p.m.
Average annual duty	163.6 ft.-lb. per B.t.u.
Best duty guaranteed, 50 m.g.d., 336 ft. hd.	168 ft.-lb. per B.t.u.
Cost of two units erected	$272,000.
Cost per brake hp., approx.	$30

Turbine	High Pressure	Low Pressure
Stages	15	7
Diam. largest wheel, in.	23.2	47.3
Length tur. shaft, c. to c. bearings, in.	70	51.5
Reduction gears: Pitch diam. driven gear, in.		55.8
Gear ratio: h.p., 7.54; l.p., 5.81		
Pumps	Two single-stage cent per unit	
Condensers, two-pass surface	C. H. Wheeler Mfg. Co.	
Condensing surface, sq.ft.	6,700	
Air ejector	Two-stage Wheeler radojet	
Condensate pump	De Laval, 4-in., 2,200 r.p.m.	

Gasoline Engine Driven Generating Unit

Engine, Sterling, 6-cylinder, 5¾ x 6¾ in.	
Generator and exciter: 90 kw. at 0.8 p.f., 1,200 r.p.m.	General Electric Co.
Economy, lb. com. gasoline per b.hp.: ½ load, 0.92; ¾ load, 0.65; full load, 0.65.	
Cost of unit complete, with storage tank, silencer, etc.	$7,927.

Turbine Driven Generating Units

Units, two, Moore turbines, Allis-Chalmers generators, Worthington condensers, capacity of each at 0.8 p. f., kw.	300
Bled steam capacity at 50 lb. pressure, lb	9,000
Speed, r.p.m.	3,600
Cost of two turbines and generators	$29,304
Condensers, surface, sq.ft.	579
Cost of one condenser and auxiliaries	$6,875

Low-Head Pumping Units

Manufacturer	De Laval Steam Turbine Co.
Units, three: two 60 m.g.d, one 120 m.g.d.; av. hd. 40 ft.; single-cylinder turbine geared to single-stage pump.	

	60 m.g.d.	120 m.g.d.
Max. b.hp.	480	960
Max. speed, turbine, r.p.m.	6,000	6,000
Max. speed, pump, r.p.m.	299	226
Average annual duty	133.7	142.9
Best duty guaranteed	136.6	145.9
Cost of 3 units		$208,000
Cost per b.h.p., approx		$104
Turbines:		
Stages	10	10
Diam. largest wheel, in.	22	26
Reduction gears:		
Pitch diam. dr. gear, in.	77.75	122.875
Gear ratio	20.06	26.57

Pump	Three single-stage centrifugal
Condensers, two-pass surface	C. H. Wheeler Mfg. Co.
Condensing surface, sq.ft.	1,500 2,400
Air ejectors	Two-stage Wheeler radojet
Condensate pump	De Laval, 2½ in., 2,200 r.p.m.

Boiler Feed Pumps

Three 4-stage, 3-in., 200 g.p.m. 400 lb. hd., 3,600 r.p.m., two motor dr., one turbine dr.	Worthington Pump & Mach. Corp.
Cost of 3 units	$6,500
Cost per water hp. (46 water hp. each pump)	47

Feed Water Heaters

Two deaërating open heaters.	Cochrane Corp.
Capacity, lb. per hr., 100 deg. to steam temp.	65,000
Cost of both heaters	$5,449

Evaporators

Two, single-effect	Griscom-Russell Co.
Capacity each, net distilled water per hr., lb.	2,400
Operating pressure	Open heater, 5 lb.; evaporator, 50 lb.

Valves

Steam and water valves, h.p.	Chapman Valve Mfg. Co.
Hydraulic valves	Michigan Valve & Foundry Co.
Check valves, h.p. mains	Automatic Cone Valve Co.
Atmospheric relief valves	Cochrane Corp.
Reducing valves	Fisher Governor Co.
Pressure-regulating valves	Fisher Governor Co.
Excess-pressure regulators	Fisher Governor Co.

Miscellaneous Equipment

Coal and ash handling	Stephens-Adamson Mfg. Co.
Magnetic separator	Dings Magnetic Separator Co.
Coal, crusher, ring type, 100 tons per hr.	American Pulverizer Co.
Weigh larries	Richardson Scale Co.
Gratings	Irving Iron Works Co.
Water softener, zeolite, 1,000 gal. per hr.	Paige & Jones Chem. Co.
Lubricating-oil filtering system	S. F. Bowser & Co.
Oil purifiers, centrifugal	De Laval Separator Co.
Traveling screens at intake	Chain Belt Co.
Sump pumps	Dayton-Dowd Co.
Steam traps	Armstrong Machine Works
Water meters, Venturi	Builders Iron Foundry
Steam flow—CO_2 meters	Republic Flow Meters Co. Brown Instrument Co.
Air-flow meters	Bailey Meter Co.
Pressure gages	Foxboro Co.; Crosby Steam Gage & Valve Co., Ashton Valve Co.
Switchboards	Wurdack Electric Co.
Electrical meters	Weston Electrical Instrument Corp.
Switches and circuit breakers	Condit Elec. & Mfg. Co.
Motors, 180	Allis-Chalmers Mfg. Co. General Electric Co. Louis Allis Co.
Transformers, Pittsburgh	Allis-Chalmers Mfg. Co.

Accumulator Smooths Out Pressures in Anheuser-Busch Plant

WHILE the steam accumulator has been widely used for years in Europe, its western penetration, well started in Canada, has only just begun to make itself felt in the United States. The average American engineer has little or no first-hand acquaintance with the steam accumulator and is, therefore, interested in information showing what it can accomplish under American conditions.

Fig. 1 shows the Ruths steam accumulator that has been in operation for approximately one year at the Anheuser-Busch plant in St. Louis. With a diameter of 14 ft. and a length of 59 ft., this accumulator has a volume of 8,400 cu.ft. and a storage capacity of 30,000 lb of steam between 150 lb. and 50 lb. pressure.

A new boiler house is now under construction, with steam generating equipment designed for a pressure of 465 lb. When this is finished, non-condensing, bleeder type turbines will generate all power required. The bleeder pressure will be 150 lb. and the exhaust pressure 5 lb. The accumulator will continue to operate between 150 lb. and 50 lb. pressure, as originally designed.

At present the accumulator receives its steam directly from 150-lb. boilers, exhausting to process at 30 lb. Fig. 2 shows the fluctuations of boiler pressure before the accumulator was installed. A variation in pressure from 80 lb. to 160 lb. will be noted.

Fig. 3 shows the boiler pressure constant at slightly less than 150 lb. and the low-pressure steam constant at 30 lb., after installation of the accumulator. Between these two the accumulator pressure varies widely without any effect on boiler or process pressure.

The steam accumulator stores energy in the form of hot water. When the boiler pressure tends to rise, the excess steam over the demand is admitted to the accumulator, where it condenses, raising the temperature of the stored water. Conversely, when the demand for steam exceeds that supplied by the boilers, the difference is released from the hot water by lowering the pressure and causing some of the water to flash into vapor.

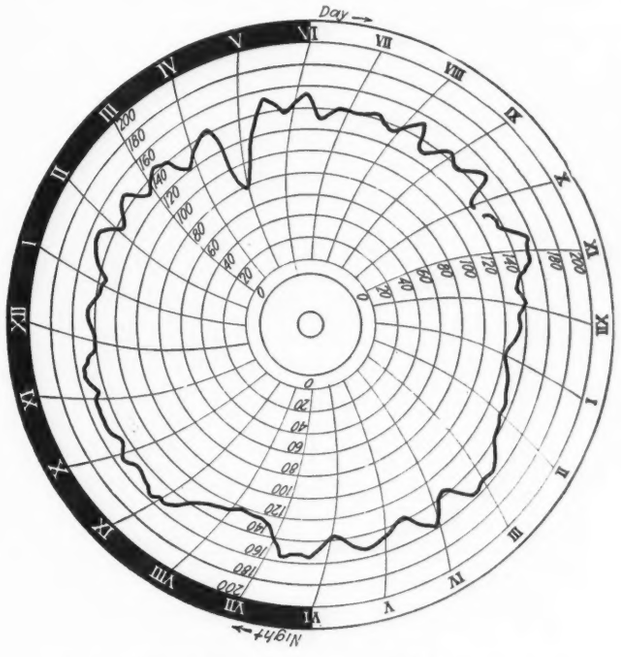


Fig. 2—Variations in boiler pressure before installation of accumulator

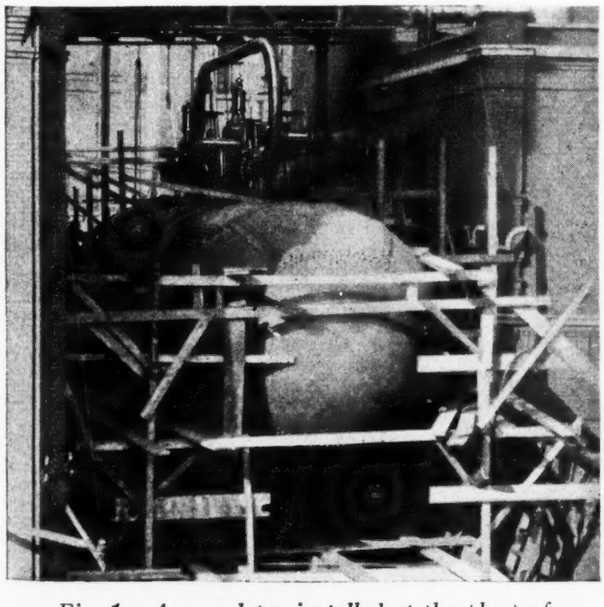


Fig. 1—Accumulator installed at the plant of Anheuser-Busch, Inc.

It is 14 ft. in diameter by 59 ft. long and has a storage capacity of 30,000 lb. of steam between 150 and 50 lb. pressure.

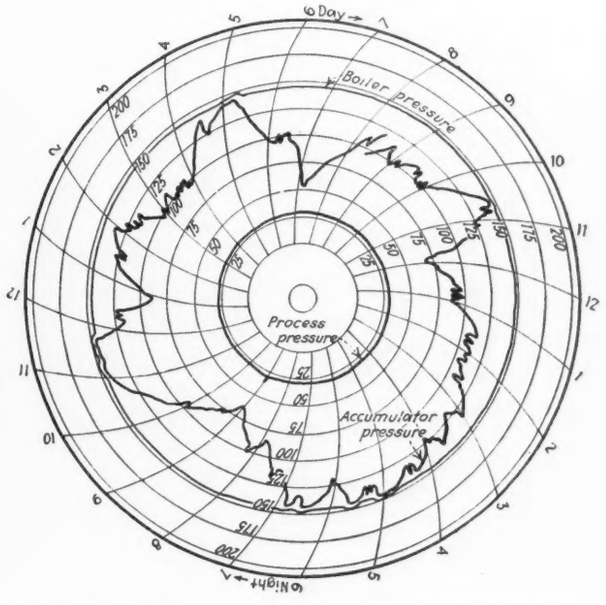


Fig. 3—Boiler pressure and process pressure are constant at 150 lb. and 30 lb. respectively, while accumulator pressure varies widely between these limits

Over 4,000 Hp. of Motors

in New York Life Insurance Company's Building

POWER is required in a large office building for a wide variety of services. Outside of the ten or more applications in the power and heating plant there is a wide range of motor applications on house, fire, sump and other pumps, refrigerating machinery, air compressors, vacuum cleaners and ventilating services. In many cases motors are required for pneumatic-tube systems, blowers, conveyors, restaurant, mailing department and other service. In the New York Life Insurance Building, 51 Madison Avenue, New York City, the motor applications are representative of the wide diversity required in a modern building.

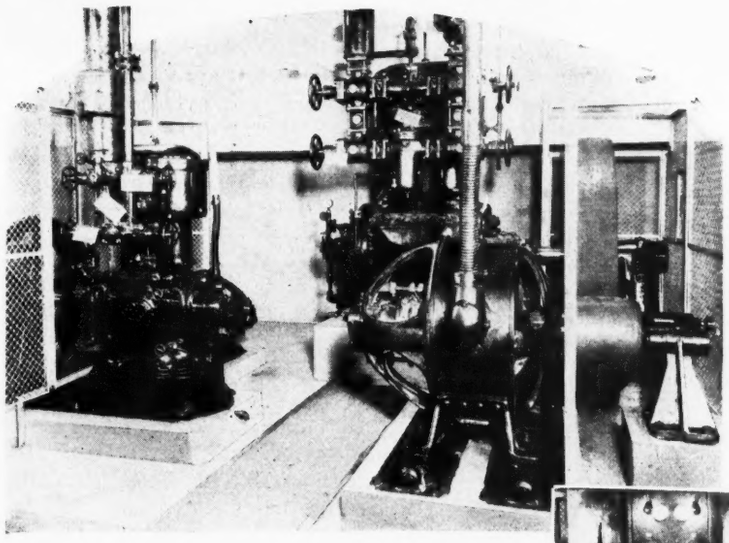
This building, designed by Cass Gilbert, Inc., architects, is the company's home office. It is one of New York's most beautiful structures and has been equipped to meet every need of a large insurance company. The building occupies the block made famous by Madison Square Garden, extends 617 ft. above the street level and five stories below and has a rentable floor area of 925,000 sq.ft. Of this area the company occupies about 600,000 sq.ft. Arrangements have been made to provide every modern convenience for the company's 3,500 employees, such as dining rooms, medical welfare rooms and other services. To handle the large amount of interoffice mail and other material, a pneumatic-tube system has been installed, which at the present time has 43,000 ft. of tubing. To serve the company's dining rooms and for other purposes there are eleven dumbwaiters. Elevator service is taken care of by 31 high-speed passenger machines, four special elevators, and two high-speed and one slow-speed freight. For all purposes a total of over 4,000 hp. of motor capacity is required. Of this over 2,500 hp. is for applications outside of elevator service.

In this building motor applications begin with the coal-handling equipment. There are a shaker feeder, two belt conveyors and a trimmer, the latter to distribute the coal across the bunker. For operating these equipments four motors are required, with a total capacity of 12 hp. One motor operates the shaker feeder, another drives the two conveyors and two operate the trimmer. These motors are compound wound, are geared to their respective loads and have push-button control. The feeder and conveyor motor controls are interlocked so that if the conveyor stops the feeder will also stop and the feeder motor cannot be started until the conveyor motor is running. This arrangement prevents the feeder from piling coal on the conveyor should it stop running for any reason. Stop-button stations are located at several points along the conveyor. Although the conveyors and feeder can be stopped from any one of the stop stations, they can be started only by going to the control located at the motors.

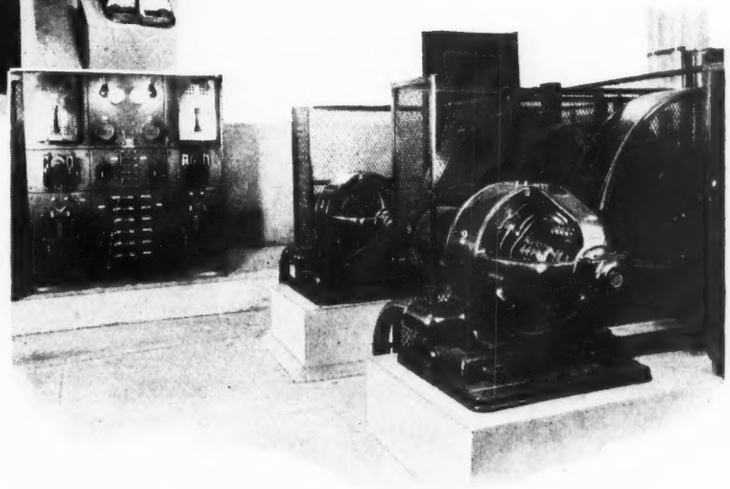
A three-horsepower compound-wound motor with push-button control operates the coal lorry. This motor is geared so that it can be used to operate the conveyor to distribute the coal to the stoker hoppers or it can be used to drive the lorry from one place to another.

Including the elevator machines there is a connected load of over 4,000 hp. of electric motors installed. Over 200 motors with an aggregate capacity of about 2,500 hp. are required for building services outside of the elevators. Flexibility, reliability and easy maintenance are outstanding features of the design.

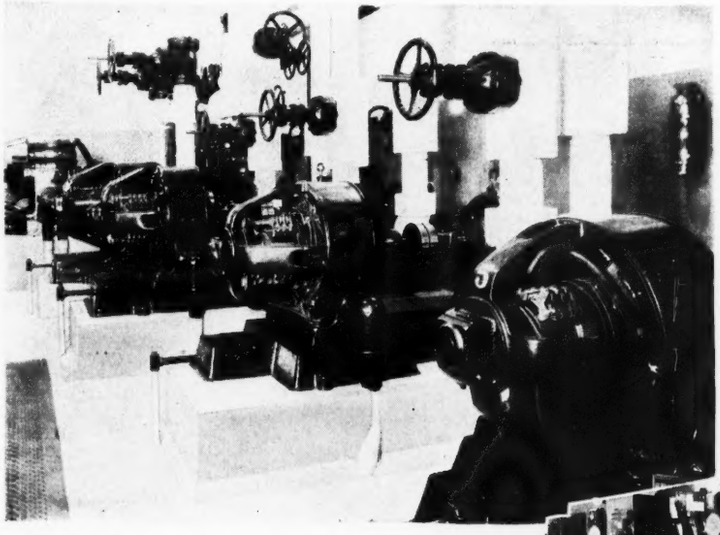
Compressor and Pump Motor Applications

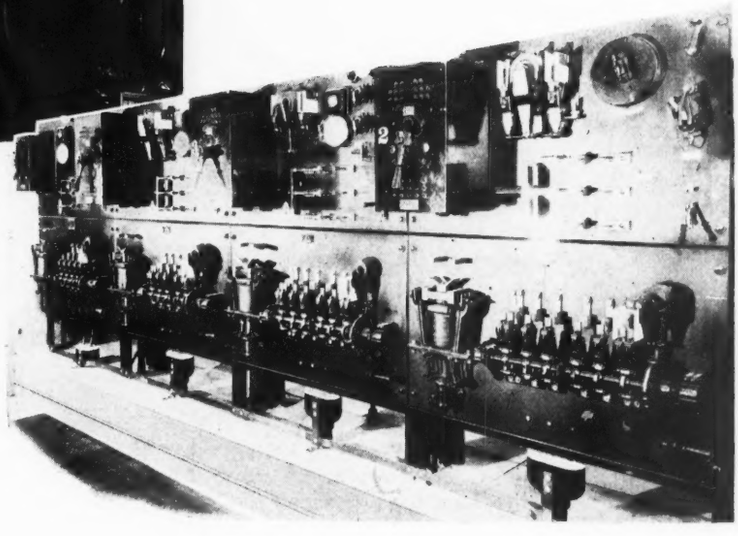


Two of the four ammonia compressors. Three of the compressors are driven by 75-hp. motors and one by a 25-hp. motor. These motors have push-button control and are stopped automatically in case of low water on the cylinder jackets or high-head pressure

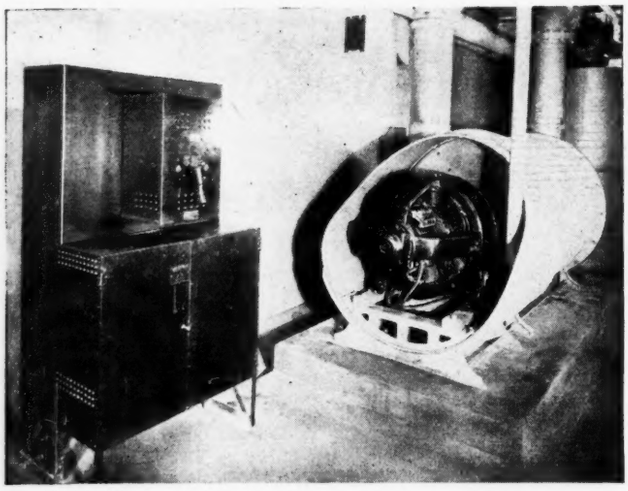


The two air compressors for the sewage ejectors are driven by 75-hp. motors. These motors are started and stopped automatically by pressure-switch control. By means of double-throw switches on the control panels any combination of the two controls may be used on either motor





Above are shown the four house-service pumps and the fire pump. On the right are the controllers for the house-service pumps. Both float-switch and manual control are provided for the house-pump motors. One of the house pumps is a spare and can be connected to take the place of any one of the three regular service pumps or the fire pump in emergencies



One of the two vacuum cleaners driven by 75-hp. motors

All the motors on the coal-handling equipment are of the constant-speed type. Each stoker is driven by a 1.5-hp. compound-wound motor that has a 1-to-3 speed range by field control. The motors are mounted on pedestals at the rear of the boilers, are connected to the gear box on the stoker by a short-center belt drive with an idler pulley. The belt runs on pulleys that have two steps, which allow a 1-to-2 speed change. The pulleys in combination with field control of the motor give a stoker speed range of 1 to 6. Manual control is used and the control boxes are mounted on the front of the boilers where they are convenient for the operators.

Since the plant is for heating purposes, the boiler-feed pumps and the forced-draft fans are driven by steam turbines, and the exhaust used to heat the feed water. One of the forced-draft fans can be driven by either a turbine or a constant-speed motor. The turbine is coupled to the fan and the motor drives through a short-center belt with an idler pulley. As this motor is intended primarily for driving the fan during emergencies, it is provided with manual control located at the motor.

An 85- to 102-hp. shunt motor drives the blower on the ash ejector. This motor is started manually and a rheostat is provided in the field circuit for adjusting its speed from 3,500 to 4,000 r.p.m.

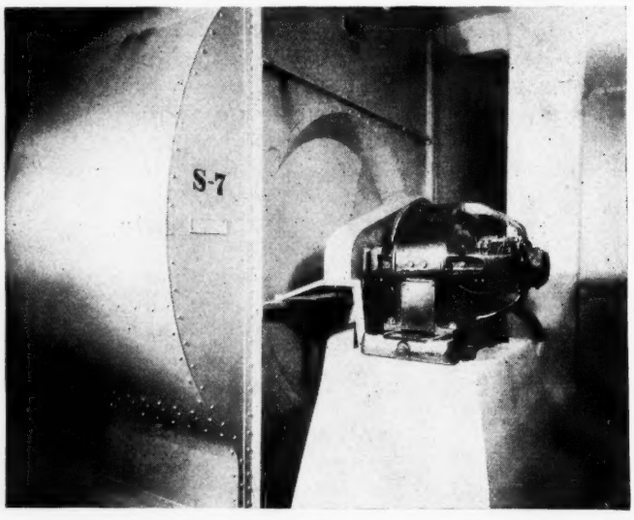
On the boiler blowdown tanks are two pumps driven by 10-hp. compound motors with automatic float-switch controls. A double-throw switch on the control allows either motor to be connected to either control. Normally, No. 1 motor is started and stopped by No. 1 control and No. 2 motor by No. 2 control. If so desired No. 1 control can be used on No. 2 motor and No. 2 control on No. 1 motor. A single-pole switch is also provided on the control to short-circuit the float switch and start and stop the motors at will if the float switch is open.

There are four sumps in the basement. Each of the sumps has two pumps. In two the pumps are driven by 20-hp. motors and in the other two 15-hp. motors drive the pumps. In each sump are two float switches, one set at a lower level than the other. One motor is started and stopped by the low-level switch and the other motor is controlled from the high-level switch. As the water rises in the sump, the low-level switch closes first to start one of the pumps. If the water continues to rise, at a certain level the high-level float switch closes to start the second pump. In case the water continues to rise above the high-level float, a high-water alarm is sounded at the pump control panels and in the chief engineer's office to call attention to the conditions. Normally, one pump has sufficient capacity to take care of the water in the sump easily.

By the use of double-throw switches on the control board any combination of float switches, controls and motors may be obtained. This arrangement allows equalizing the service on the two pumps and at least one pump and control are always ready to go into service.

The fire pump is the largest unit in the building and is driven by a 200-hp. compound adjustable-speed motor. The pump has a capacity of 750 g.p.m. against a 670-ft. head. Manual starting is used with five-point field adjustment for speed control. A speed range of 1,300 to 1,750 r.p.m. may be obtained.

There are four house-service water pumps: two, the high-rise pumps, are driven by 100-hp. 1,750-r.p.m. motors; one, an intermediate-rise pump, is driven by a 75-hp. 1,750-r.p.m. motor and the low-rise pump is driven by a 40-hp. 1,750-r.p.m. motor. The motors are compound



Shunt motors with a speed range of 575 to 800 r.p.m. drive the ventilating fans

wound and are directly connected to the pumps, which are of the centrifugal type. All the motors are automatically controlled from float switches and have high- and low-water alarms, consisting of a bell, a red and a green lamp. One of these alarms is on each of the control panels and duplicates of them are in the chief engineer's office.

A three-pole double-throw switch on the control panels allows changing from float-switch to pilot-switch control. From the pilot switch the pump motors may be started and stopped at will.

One of the high-rise pumps is driven by an adjustable-speed motor, with a speed range of 1,150 to 1,750 r.p.m. and is used as a spare pumping unit. By a suitable valve and piping arrangement this pump can be connected into the fire, high-rise, intermediate-rise and low-rise service lines. A double-throw two-pole switch on each control panel allows connecting the float switch on any service-water tank to the spare-motor control. A three-point rheostat in the field of the motor permits adjusting its speed to suit the water pressure required for the level to which the pump is delivering. Contacts on the rheostat also interlocks the float switch in such a way that

the motor cannot be started unless the rheostat is set to give the correct motor speed.

On the four service-pump panels there is also a manual control for emergency use. A three-pole double-throw switch connects the motor to either the automatic or the manual control. This combination of controls and motors makes the service about as nearly 100 per cent reliable as it is possible to obtain.

To circulate the ice water, four pumps are provided. Two of these are operated by 7.5-hp. shunt motors and two by 5-hp. motors with manual control.

On the heating system there are six vacuum-return pumps driven by 10-hp. shunt constant-speed motors. Manual, vacuum-switch and float-switch control are provided. Normally, during the winter months, operation is by manual control. In the early fall and spring, when the heating load is light, the pump motors are operated on vacuum and float-switch control.

The two blowers on the pneumatic-tube system are driven by 75-hp. constant-speed compound motors. A combination push-button and automatic control is used. One motor is normally on push-button control. If the load increases beyond the capacity of one blower, the second motor cuts in automatically and when the load again drops to within the capacity of one blower the last machine to start is shut down automatically. By means of double-throw switches on the control either motor may be put on push-button control.

There are two machines on the building vacuum-cleaning system. These are driven by 100-hp. constant-speed shunt motors with manual control. All cleaning is done at night, and it is during this period only that the machines operate.

Two air compressors driven by 75-hp. compound motors supply air to the sewage ejectors. The motors are started and stopped by pressure-switch control. Each motor is provided with a circuit breaker, a pressure switch and an automatic starter. By means of double-throw switches on the control panel it is possible to use any one of the circuit breakers, pressure switches or automatic controls on any one of the motors.

In the refrigerating plant there are four compressors, three of 30 tons capacity driven by 75-hp. compound motors, and one 10-ton unit driven by a 25-hp. compound motor. All four motors are connected to the compressors by short-center belt drives and idlers. The motors operate at constant speed and have automatic starters. They are started and stopped by closing or opening a pilot switch on the control panels. In case of low water on the cylinder jackets or high-head pressure, the motors shut down automatically. Included in the refrigerating equipment are four brine pumps, two driven by 15-hp. and two by 5-hp. shunt motors. These motors operate at constant speed and have manual control. There is also an agitator and a core set, each driven by a 1.5-hp. shunt motor having a manual starter.

On the ventilating system there are 56 motors driving 29 supply fans and 27 exhaust fans. These motors range in size from 30 to ½ hp. and are equipped with manual control. A speed adjustment ranging from 575 to 850 r.p.m. is obtained with field control. On all supply fans air filters are used. The filters are washed with oil, which is supplied by motor-driven pumps. These pump motors are started automatically with the closing of the line switch.

The power installation throughout the building is representative of the best design and construction. Reliability and flexibility have been incorporated in the layout to give as nearly 100 per cent service as is humanly possible.

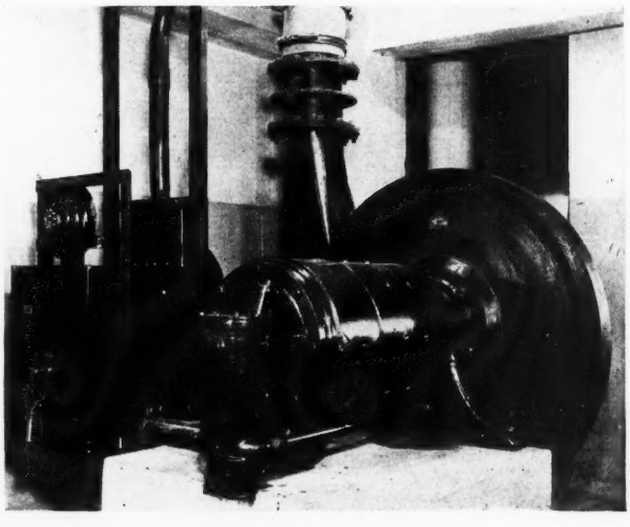
The author wishes to express his appreciation for the assistance rendered by S. Barnaby, superintendent, and H. W. Wilds, chief engineer of the New York Life Insurance Company's building for their assistance in the preparation of this article.

PRINCIPAL MOTOR APPLICATIONS*

No. of Units	Applications	Motor, Hp.	Total, Hp.	Type	Speed, R.p.m.	How Controlled	Type of Drive
1	Coal conveyor..	5	5	Comp.	850	Push-button	Gear
1	Coal feeder.....	3	3	Comp.	1,150	Push-button	Gear
1	Coal trimmer...	3	3	Shunt	.....	Push-button	Gear
1	Coal trimmer...	1	1	Shunt	.....	Push-button	Gear
1	Coal lorry.....	3	3	Comp.	1,150	Manual.....	Gear
5	Stokers.....	1.5	7.5	Comp.	500 1,500	Manual.....	Belt
1	Ash ejector.....	85	85	Shunt	3,500 4,000	Manual.....	Direct
1	Forced-draft fan	25	25	Shunt	1,150	Manual.....	Belt
6	Vacuum pumps.	10	60	Shunt	1,750	Float or vacuum switch	Direct
2	Blowdown tank pumps.....	10	20	Comp.	1,750	Float switch	Direct
4	Sump pumps...	20	80	Comp.	1,150	Float switch	Direct
4	Sump pumps...	15	60	Comp.	1,150	Float switch	Direct
1	Fire pump.....	200	200	Comp.	1,300 1,750	Manual.....	Direct
1	House pump...	100	100	Comp.	1,750	Manual or float switch	Direct
1	House pump. (spare).....	100	100	Comp.	1,150 1,750	Manual or float switch	Direct
1	House pump...	75	75	Comp.	1,750	Manual or float switch	Direct
1	House pump...	40	40	Comp.	1,750	Manual or float switch	Direct
3	Ammonia compressors.....	75	225	.....	1,150	Push button.	Belt
1	Ammonia compressors.....	25	25	.....	1,150	Push button	Belt
2	Brine pumps...	15	30	Shunt	1,750	Manual.....	Direct
2	Brine pumps...	5	10	Shunt	1,750	Manual.....	Direct
2	Ice-water pumps	7.5	15	Shunt	1,750	Manual.....	Direct
2	Ice-water pumps	5	10	Shunt	1,750	Manual.....	Direct
1	Core set.....	1.5	1.5	Shunt	1,725	Manual.....	Direct
1	Agitator.....	1.5	1.5	Shunt	1,725	Manual.....	Direct
2	Vacuum cleaners	100	200	Shunt	1,750	Manual.....	Direct
2	Pneumatic-tube blowers.....	75	150	Comp.	1,750	Push-button	Direct
2	Air compressors	75	150	Comp.	1,150	Pressure sw..	Belt
2	Elev.-door air compressors.	25	50	Comp.	1,150	Pressure sw.	Belt
1	Ventilating fans	30	30	Shunt	575 850	Manual.....	Mult. V-belt
4	Ventilating fans	20	80	Shunt		Manual.....	Mult. V-belt
6	Ventilating fans	15	90	Shunt		Manual.....	Mult. V-belt
10	Ventilating fans	12.5	125	Shunt		Manual.....	Mult. V-belt
11	Ventilating fans	10	110	Shunt		Manual.....	Mult. V-belt
2	Ventilating fans	7.5	15	Shunt		Manual.....	Mult. V-belt
1	Ventilating fan.	5	5	Shunt		Manual.....	Mult. V-belt
4	Ventilating fans	3	12	Shunt		Manual.....	Mult. V-belt
5	Ventilating fans	2	10	Shunt		Manual.....	Mult. V-belt
4	Ventilating fans	1.5	6	Shunt		Manual.....	Mult. V-belt
2	Ventilating fans	1	2	Shunt		Manual.....	Mult. V-belt
2	Ventilating fans	0.75	1.5	Shunt		Manual.....	Mult. V-belt
4	Ventilating fans	0.5	2	Shunt		Manual.....	Mult. V-belt
9	Conveyors.....	3	27	Shunt	1,150	Push button	Gear
2	Rolling doors...	3	6	Comp.	.....	Push button	Gear

*Over 100 additional motors are used for the air cleaners on the ventilating system, machine shop, the kitchen and for other services. These range in size from 10-hp. capacity down.

Ash-ejector blower motor operates at 3,500 to 4,000 r.p.m.



Friction Losses in Large Check Valves

By L. A. QUAYLE
Chief Engineer, Department of Public Utilities

DATA from friction-loss tests made on large water check valves of five different sizes have been assembled and put in curve and tabular form, and show not only the friction drop through these large valves for a considerable velocity range, but also the importance of the piping arrangement on the upstream side of the check valves. The pressure drop was measured by a mercury manometer connected each side of the check valve, in a straight run of pipe when possible. Where this could not be done, tests were made to determine the location of a connection that would give approximately the average pressure. The characteristics of the various curves can probably be explained as follows:

The two 30- and 42-in. diameter type 1 check valves are of the same general design as shown in the sketch. The 30-in. valve is connected to a 20-m.g.d. centrifugal pump, and the 42-in. to a 25-m.g.d. triple-expansion pumping engine. The piping is so arranged that the water flows through practically straight runs of pipe before entering the check valves. Note that these curves are about parallel to each other and very close together.

CHECK VALVE DIMENSIONS

Curve Designation	Type of Valve	A In.	B In.	C In.	D In.	E In.	Number of Gates	Approx. Weight of Each Gate, Lb.	Total Area of Valve Openings, Sq. Ft.	Area of Pipe, Sq. Ft.	Ratio Pipe to Check Valve Velocity
30" R	1	30	22	30	57	16	4	113	5.6	4.91	0.88
36" RS	2	36	36	36	62	12	11	50	8.64	7.07	0.82
42" R	1	42	28½	34½	76¾	5–16 2–18	7	16-in., 130 18-in., 167	10.51	9.62	0.92
48" R	3	48	66¼	33¾	82	20	7	190	15.27	12.57	0.82
60" R	1	60	40	40	100	24	7	280	22	19.63	0.89

The 36-in. type 2 and the 60-in. type 1 check valves are in the discharge lines of 30- and 100-m.g.d. centrifugal pumping units and have 90-deg. elbows bolted to their inlet flanges. For velocities exceeding five feet per second, these curves are very steep, probably owing to the crowding of the water by the elbow to one side of the check, causing an unbalanced pressure condition in the check valve, which results in about one-third of the valve ports passing much more water than the others.

During the eleven years that three 60-in. check valves of this type have been in service at Division Station, Cleveland, it has been found that the wear on the valve shafts and bushings on the side to which the elbow crowds the water is two or three times that of the valves on the other side. The odd shape of the 36 R.S. valve curve below five feet per second is due to the fact that 0.3 lb. pressure was required to open it against the weight of the valves on the 21-deg. angle.

The flatness of the friction loss curve for the 48-in. diameter type 3 check valve is due, I believe, to the special upstream cone, which we designed for all our large Fairmont Station check valves. This gradually tapering cone apparently cuts down the eddy losses.

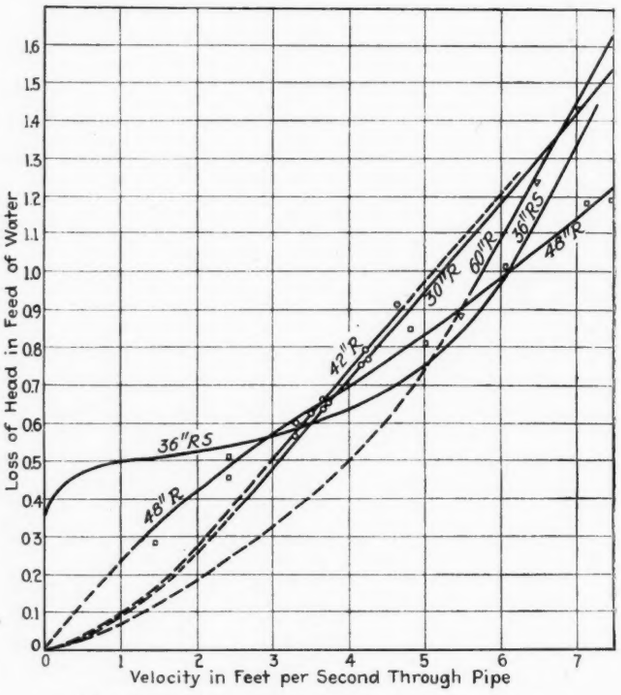


Fig. 2—Friction loss through check valves

Summarizing briefly, the check valve with the special upstream cone gave the lowest friction drop in the working range of the check valve. Type 1 checks with the water flowing practically straight into them gave the next best results; and the greatest friction drop was obtained on the checks with entrance elbows.

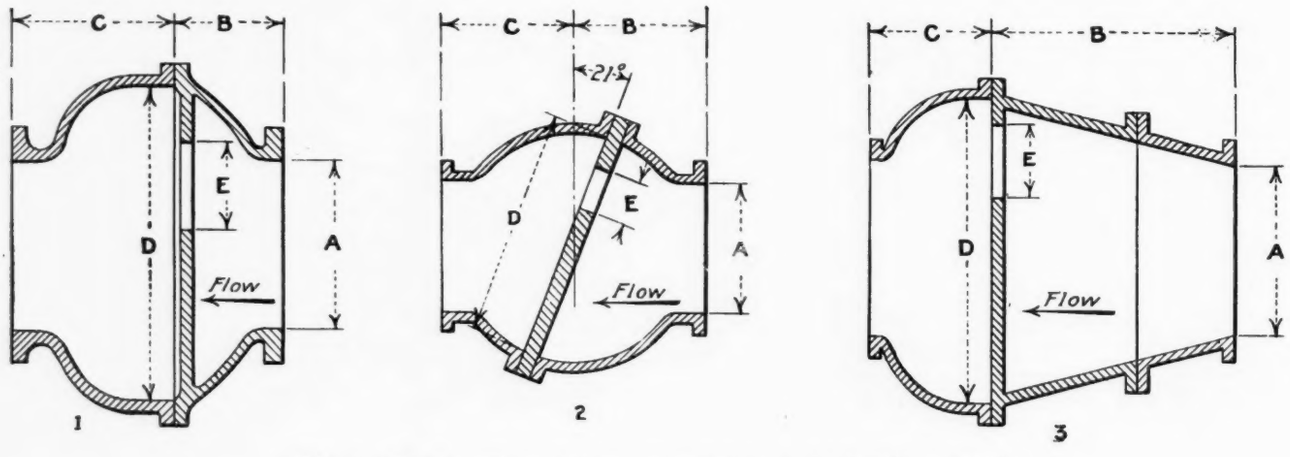


Fig. 1—Cross-section of the various types of check valves tested

Facts for the Engineer on DAIRY REFRIGERATION

By C. T. Baker
Consulting Engineer

THE engineer in charge of power and refrigeration in the modern dairy plant has much machinery and equipment under his charge for which he is directly responsible.

Some of these are pasteurizers, cream separators, milk coolers, milk-bottling machines and evaporators. Generally, too, quite a sizable refrigerating plant is employed to furnish refrigeration for purposes such as cooling and storage. Unfortunately, information pertaining to the application of refrigeration to the dairy that may enable the plant engineer to handle better and apply refrigeration to the uses of the industry is lacking, and this article is intended to supply some ideas on the subject.

The only safe method of preserving milk and its products is by means of dependable temperature control. This is usually accomplished by first pasteurizing the milk, which consists in passing it through pasteurizers that quickly heat it to 144 deg. F., after which it is held at that temperature for about 30 minutes.

If the temperature of the milk is not raised to 144 deg., it will not be pasteurized properly, and therefore a high bacteria count is likely to result. On the other hand, if the pasteurizer temperature is in excess of 144 or 145 deg., the quality of the milk after treatment is not considered so good and complaints are usually had from the consumer that very little cream is obtained, since very little appears on the top of the milk after being bottled.

Temperature Control Necessary

One of the things quite essential in the pasteurization of milk is dependable temperature control, one such as will maintain uniform, predetermined temperatures throughout the entire time range of pasteurization. Accordingly, temperature controllers for this class of work must be sensitive and dependable.

After the milk has been pasteurized it becomes necessary to remove the heat from it as quickly and efficiently as possible. This is done partly by means of water at ordinary temperatures and partly by the use of cold brine or direct expansion ammonia.

One of the things necessary for the refrigerating engineer to know in his calculations to determine the necessary refrigerating capacity for a given dairy or milk plant is the specific heat of milk and cream. The specific heat is not constant, but varies somewhat with the analysis of the milk, which, in turn, varies with the percentage of cream, total solids and water. These properties often range through considerable limits for different milk. For example, some milk samples will contain 70 to 72 per cent water, while still other samples will contain as much as 88 per cent. Likewise, the percentage of solids in milk will often vary through wide limits. Therefore, the specific heat may vary from 0.92 to 0.94, and in some instances where the cream content is high the specific heat may be as high as 1.05, with a milk temperature of 65 deg.

Specific Heat Must Be Known

It has not always been possible to know these things in advance, and under such conditions it is well to make liberal allowances for the specific heat in order that the apparatus installed for milk cooling may be adequate for handling the required amounts in a specific time. Generally, the value of one is used where exact information regarding specific heat is not obtainable, this being the specific heat of water.

The freezing point of milk varies somewhat with its composition, but is always lower than that of water and may vary from 31 to 29 deg. F. The addition of water to milk always raises its freezing point, and if enough be added, its freezing point will, of course, be the same, or nearly the same, as that of water. Likewise, any increase in the fat and solid content will depress the freezing point.

Milk that has not been previously pasteurized properly, if held at a temperature of 32 deg., may permit the slow growth of bacteria of certain types. However, a good quality of milk, free from bacteria when placed in storage, may be held for several weeks before any appreciable growth of bacteria is noted and even then the rate of growth is slow.

Wherever milk or dairy products are stored, the rooms should be finished in white so as to afford a cleanly appearance. Concrete floors should be arranged with drains to permit washing down with hot water at regular intervals. Cork is employed as the insulating material on rooms of this character, being plastered on the inside with cement mortar. This mortar should be troweled down to a smooth dense surface and then given one or possibly two coats of cold-water paint to improve the appearance and at the same time to close the pores of the cement mortar.

Generally, the cooling coils are arranged along the walls, but may be placed just below the ceiling, provided protection is afforded against dripping of water from the melting of frost when the coils are being defrosted. Sometimes, in the larger rooms bunker-coil construction is used, which places the cooling coils in a loft above

the ceiling, with passages provided for the descent of the cold air and the uptake of the warm air. This method of coil construction is, of course, more expensive but insures good circulation and uniform temperature.

Temperatures from 31 to 32 deg. F. should be carried in the milkrooms, and in order that the temperature variation shall not be excessive, automatic temperature control of the various rooms should be employed. This may be done irrespective of whether the rooms are cooled by means of brine circulation or of direct-expansion ammonia.

In some of the smaller dairy plants brine tanks are installed in the milk-cooling rooms, which are fitted with direct-expansion piping submerged in brine. During the daytime, while the refrigerating machine is being operated, the brine is cooled down as well as the rooms themselves; then at night, when the plant is shut down, the cold brine, acting as a holdover storage, prevents the room temperatures from going up excessively until the machine is again started.

The objection to such an arrangement is that tanks take up valuable space in the storage room and the frost accumulating on the tank sides acts as an insulator, causing the brine to take up heat much more slowly during the hold-over period while the machine is idle.

When to Use Automatic Plants

If the plant is a comparatively small one, complete temperature control is best obtained by the use of a full automatic refrigerating plant, while in the case of larger dairies that are operated continuously, temperature control is best obtained in the individual rooms and departments by automatic temperature-control mechanism located in or near each room. Such an arrangement is superior to the hold-over tank design in many respects, one being that it is much easier to keep the rooms properly cleaned when there are no tanks or tank supports.

Another advantage of the automatic temperature control of milkrooms is that the temperature may always be prevented from falling low enough to cause the milk or cream to freeze, for clots of fat and albumen will result when it is thawed out.

Not all dairies pasteurize milk as it is received, but simply bottle and store the raw milk. Where raw milk is stored, the cooling is done usually with brine in a tubular cooler. This apparatus is not arranged for the use of water in the upper section for removing some of the heat, owing to the fact that milk is delivered to the dairy at fairly low temperatures.

In plants where pasteurizing is practiced and the milk subsequently cooled with either brine or ammonia, the upper sections of the milk coolers are equipped for using water to take up the heat above 85 deg. This cooling by water represents a decided saving in refrigeration and therefore a saving in the operating cost of the refrigerating plant as a whole. Also, it enables a smaller plant to be installed for a given milk-cooling capacity.

Where milk is cooled by means of cold brine, it is customary to install a brine tank large enough to permit of a considerable quantity of brine being cooled before the milk coolers are placed in operation. This permits the use of a much smaller compressor than would be required if it were necessary to cool a large quantity of milk through a considerable range of temperature without first having stored up a definite amount of refrigerating capacity in the brine.

In calculating the amount of heat to be taken up by the refrigerating machine for any given case, it is necessary to obtain first the following information:

1. Quantity of milk in gallons to be cooled, and weight per gallon.
2. Time in which the cooling must be performed.
3. Temperature of the milk delivered to the brine or ammonia section of the milk cooler.
4. Temperature to which the milk is to be cooled by the milk cooler.
5. Heat to be removed from the milk after being placed in storage and the time in which such heat must be removed.
6. Heat leakage through the insulated walls, floors and ceiling of the milk storage room per day, to which about 10 per cent should be added for the opening of doors and burning lights.
7. Heat that must be taken up in cooling the bottles and cans in which the milk is placed after leaving the milk cooler. Milk containers must be cooled to the temperature of the storage room; therefore this cooling must be taken into consideration and it calls for a knowledge of the initial temperature of the containers, which is usually that of the room in which the empty containers are stored.
8. If butter or other milk products are to be stored, the amount that must be cooled per day and the range through which the cooling is to be done must be known.
9. If ice is to be produced, the daily tonnage must be known as well as the temperature of the water from which ice is to be frozen.

The time of maximum heat absorption will be that of the milk-cooling period, but knowing what this peak load will amount to, the capacity of the brine storage tank may be calculated. This should be large enough to hold sufficient brine to afford, when cooled to 10 deg. F., ample heat-absorbing capacity for taking up and storing heat during the peak load period.

Amount of Refrigerant Needed

Usually, the amount of brine stored in such tanks will vary somewhat, depending upon the conditions, but will average from five to six times the weight of the milk to be cooled in any given milk-cooling period. Generally, small plants are operated from seven to eight hours a day and have two milk-cooling periods in that time. Of course, if the direct-expansion type of milk cooler is used, no brine tank is necessary for the storage of refrigeration ahead of the cooling period.

It is of course important that the refrigerating machines used in the dairy plant be operated on the highest possible suction pressure consistent with the required temperatures, in order that the lowest possible power cost per ton of refrigeration be obtained.

In plants large enough to warrant the use of two refrigerating machines it will generally be found advantageous to use direct expansion throughout in place of brine circulation, since the space is reduced, as are also the radiation losses and power costs. Likewise, there is considerable saving in repairs and maintenance when there is no brine piping or brine pump.

Automatic control of the proper amount of refrigeration admitted to milk coolers is now a practical reality, and automatic control devices for such coolers have taken the guesswork out of milk cooling and rendered such coolers safe and dependable. The same thing applies equally well to water cooling and to room cooling.

Standards Recommended for

CARBON BRUSHES

By W. C. Kalb

Engineer, National Carbon Company

Variations in Grade, Size and Style *of carbon brushes have become so numerous as to present a serious problem to plant engineers. In this article recommended standard brush dimensions are given. A second article will show the causes for the present lack of brush standards, and a third will tell the engineer how far he may go in applying standardization to the brushes on motors in his plant.*

THE NEED for standardization in brush sizes and styles is obvious to anyone who has access to the storeroom or purchasing files of the average industrial plant. The number of variations in grade, size and style of brushes approaches the total number of machines in operation so closely that one wonders how such a lack of standardization could have been attained.

Doubtless the rapid progress made in the electrical industry in the last several years has been the chief factor in preventing standardization of individual parts. The design of generators and motors in themselves has undergone frequent and radical changes. With practically every change a new type of brush-holder has appeared. This in itself usually requires a modification of the brush. Dimensions and mechanical features of the brush have been adapted to the immediate problem with too little effort to continue types formerly used or to hold to any standard for brushes in the development of a new line of machines.

Machine design has now reached a point of stability where serious thought can be given to standardization of individual parts and departure from standard specifications resorted to only where there is sound engineering basis for such action.

During the last few years much attention has been given to the subject of standardization in many lines of industry and the advantages are generally appreciated. Standard products permit standardization of production processes, thus effecting substantial saving in initial cost. The marketing of a standard product is much simpler and can be effected at lower cost to the consumer than is the case with a product that has not been standardized. The purchasing of a product on standard specifications is much simpler than one on which detailed special instructions are required, and the chances of error on the part of both the purchaser and supplier are greatly reduced.

The reduction of stocks and inventory is a very appreciable item of cost reduction when standardized products are made available. This results from the elimination of slow-moving stock, reduction in required storage space, decrease in obsolescence, reduced chance of error in application and decrease in overhead, handling charges and clerical work. Where standardization has been accomplished, the consumer has received better values than were formerly possible, better service as to delivery and, what is most important, better quality of product.

The need for standardization in brushes has long been recognized. Several years ago this subject was given exhaustive study by the Electric Power Club. While the results of their effort did not reach as far as had been hoped, they did lead to the adoption of standard limits for brush dimensions, eliminating what had frequently been a large factor in cost on the part of the brush manufacturer and a source of considerable inconvenience to the consumer. The recommendations of the Electric Power Club were published in July, 1917, and have since been used by the majority of electrical manufacturers.

In 1926 the question of brush standardization, at the request of the Electric Power Club, was taken under consideration by the Division of Simplified Practice of the Department of Commerce. A conference was called embracing representatives of brush manufacturers, motor and generator manufacturers, distributors and users. Upon the suggestion offered at this conference, a standing committee was appointed having representation from each of the four divisions of the industry above named and vested with the responsibility of reviewing recommendations intended to effect standardization of various brushes and brush shunts. The recommendations of this committee have been published in "Simplified Practice Recommendations," R56-28, by the Department of Commerce. The substance of these recommendations is given in the following:

For indicating the size of a brush the dimensions shall be given in the following order: Length, width, thickness.

> Length—The length of a brush is the maximum over-all dimension in the direction in which the brush feeds to the commutator or collector ring.
>
> Width—The width of a brush is the dimension at right angles to the length and to the direction of rotation.
>
> Thickness—The thickness of a brush is the dimension at right angles to the length in direction of rotation.
>
> Note—In the case of wedge-shaped brushes for radial-faced commutators there are two thicknesses.

Figs. 1 and 2 illustrate the foregoing definitions.

It is further recommended that lengths of rectangular and round brushes shall vary by steps of $\frac{1}{16}$ in. from $\frac{1}{4}$ to $\frac{3}{4}$ in. inclusive, by steps of $\frac{1}{8}$ in. from $\frac{3}{4}$ to 1 in., by steps of $\frac{1}{4}$ in. from 1 to 3 in. inclusive, with a final step of $\frac{1}{2}$ in. making $3\frac{1}{2}$ in. the maximum length recommended.

Recommendations for variations in width by steps of

$\frac{1}{32}$ in. from $\frac{1}{8}$ to $\frac{1}{4}$ in. inclusive, steps of $\frac{1}{16}$ in. from $\frac{1}{4}$ to $\frac{1}{2}$ in. inclusive, steps of $\frac{1}{8}$ in. from $\frac{1}{2}$ to 2 in. inclusive and steps of $\frac{1}{4}$ in. from 2 to $2\frac{3}{4}$ in., the maximum width recommended. In the list $\frac{7}{8}$ in. is omitted from the standard widths.

Recommendations for variations in the diameter of

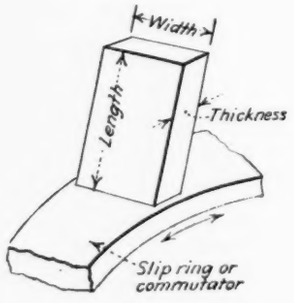


Fig. 1

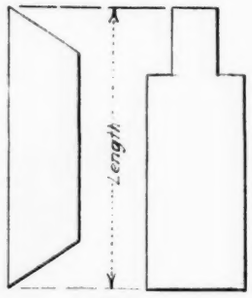


Fig. 2

Figs. 1 and 2—Recommended dimensions for brushes are to be measured as shown

round brushes are by steps of $\frac{1}{32}$ in. from $\frac{1}{8}$ to $\frac{1}{4}$ in. inclusive and made in steps of $\frac{1}{16}$ in. from $\frac{1}{4}$ to $\frac{1}{2}$ in. inclusive.

Recommendations for variations in thickness are by steps of $\frac{1}{32}$ in. from $\frac{1}{8}$ to $\frac{5}{16}$ in. inclusive, steps of $\frac{1}{16}$ in. from $\frac{5}{16}$ to $\frac{1}{2}$ in. inclusive, steps of $\frac{1}{8}$ in. from $\frac{1}{2}$ to $1\frac{1}{4}$ in. inclusive and steps of $\frac{1}{4}$ in. from $1\frac{1}{4}$ to $1\frac{3}{4}$ in., the maximum thickness recommended.

Tolerance limits on brushes were recommended as follows:

A. Rectangular and square brushes:

1. Carbon and graphite brushes.
   Length—Plus or minus $\frac{1}{32}$ inch.
   Width—Plus 0.000 or minus $\frac{1}{64}$ inch.
   Thickness and width up to and including $\frac{1}{4}$ in., plus 0.000 in., minus 0.003 inch.
   Thickness greater than $\frac{1}{4}$ in., (plain plus 0.001 in., minus 0.003 in.; (plated) plus 0.001 in., minus 0.004. (To be measured over metal coating.)
2. Metal-graphite brushes.
   Length—Plus or minus $\frac{1}{32}$ inch.
   Width—Minus 0.007 in. to minus 0.020 inch.
   Thickness—Minus 0.007 in. to minus 0.011 inch.
   Note:—For square brushes thickness limits apply to both width and thickness.

B. Round Brushes:

Size	Plain Brushes Inch	Plated Brushes Inch
Up to $\frac{1}{4}$ in., inclusive	Plus 0.000, minus 0.002	Plus 0.000, minus 0.006
Over $\frac{1}{4}$ to $\frac{1}{2}$ in., inclusive	Plus 0.000, minus 0.004	Plus 0.000, minus 0.008
Over $\frac{1}{2}$ inch	Plus 0.000, minus 0.006	Plus 0.000, minus 0.010

Bevels are defined by the committee as top bevels and face bevels with the recommendation that the latter be limited to a minimum of 15 deg. and a maximum of 35 deg., varying in steps of 5 deg. and accurate to within 1 deg. above or below specifications. These definitions are illustrated in Fig. 3. It was recommended that top bevels be 15, 30 or 45 deg.

Width of toe on beveled brushes is recommended to be $\frac{1}{8}$ of the brush thickness up to and including 1 in. thickness and $\frac{1}{8}$ in. on brushes over 1 in. thick. Tolerance plus or minus $\frac{1}{32}$ inch.

Chamfer on brushes was defined and the standard depth for the different sizes recommended as follows:

Thickness of brush (for any width)	Depth of Chamfer Inch
$\frac{1}{4}$ in. or less	$\frac{1}{32}$
Over $\frac{1}{4}$ in., but less than $\frac{1}{2}$ inch	$\frac{1}{32}$
$\frac{1}{2}$ to $\frac{1}{4}$ in., inclusive	$\frac{1}{32}$
Over $\frac{1}{4}$ in.	$\frac{1}{32}$

Tolerances plus or minus 1/64 inch.

Length of shunt was defined and recommended in the following terms: For the purpose of measuring the length of the shunt the cable shall be extended upward away from the face end of the brush in a line parallel to the lengthwise corners of the brush. The length of the flexible shunt will be the distance from the extreme top of the brush to the center of the hole or round portion of the slot in the terminal or to the center of the inserted portion of the plug terminal. Fig. 4 illustrates this definition. Except for automotive brushes or fractional-horsepower motor brushes, standard lengths of shunts for brushes one-half inch wide or over are $2\frac{1}{2}$, $3\frac{1}{2}$, $4\frac{1}{2}$, $5\frac{1}{2}$, $6\frac{1}{2}$ and $7\frac{1}{2}$ in. Tolerances on length are plus $\frac{1}{4}$ in., minus 0.000 inch.

Thirteen sizes of flexible cables are recommended for brush shunts with specifications as follows:

Number of Strands	Conductors per Strand	Diameter of Wires, Inch	Circular Mils	Nearest Size B. & S.
1	33	0.002	135	29
1	33	0.003	300	25
2	33	0.003	600	22
7	15	0.003	1,038	20
7	9	0.005	1,575	18
7	15	0.005	2,625	16
7	24	0.005	4,200	14
7	37	0.005	6,475	12
7	59	0.005	10,325	10
7	75	0.005	13,125	9
7	95	0.005	16,625	8
7	119	0.005	20,825	7
7	150	0.005	26,250	6

The diameter of hole or width of slot in shunt terminals was recommended to be:

Size of Screw	Maximum Size, Hole or Slot, Inch
No. 6	$\frac{1}{4}$
No. 8 and No. 10	$\frac{5}{16}$
No. 12 and No. 14	$\frac{3}{8}$
5/16-in. diameter	$\frac{7}{16}$
$\frac{3}{8}$-in. diameter	$\frac{1}{2}$

Tolerance limits, plus 0.000 in., minus 0.010 inch.

These recommendations in themselves do not solve the

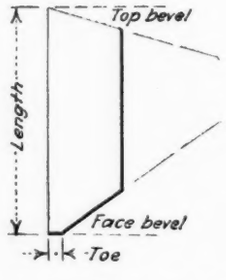


Fig. 3 — Bevel angles for brushes shall be specified as shown

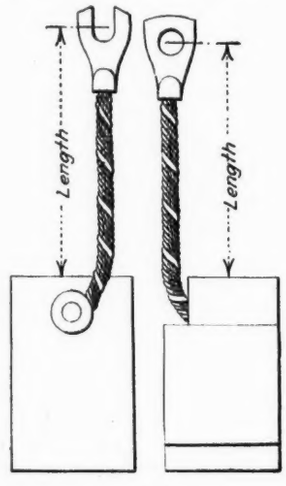


Fig. 4—The length of shunts shall be measured as shown

problem of brush standardization, but their consistent use by designing engineers in the development of new designs will go a long way in that direction. Furthermore, they suggest a basis on which the operating engineer may analyze his brush requirements and effect a substantial reduction in the styles now carried in stock.

Stoker Renewal Parts

Viewpoint of the Stoker Manufacturers Association Expressed by Howard E. Bacon

No matter how well designed and selected may be the equipment of a plant, its successful operation depends upon keeping the equipment in prime condition. Both the manufacturer and the owner are vitally interested. The manufacturer is zealous that his equipment shall have the reputation of doing well, and the owner is entitled to a just return on his investment. Poor operation reflects discredit on the plant owner. Too frequently, it may also unjustly injure the manufacturer's reputation. Consequently, the manufacturer's interest does not end with the sale of the equipment, but continues after it is in operation. It is important, therefore, that the physical condition of the stoker shall never be permitted to deteriorate to the extent that it becomes a contributing factor to poor operation.

EVERY plant owner must face squarely the problem of maintenance and renewal parts. One of the best ways to keep a stoker in proper physical condition is to establish a thoroughgoing detailed inspection at regular intervals. This will reveal promptly any defects that should be corrected or parts that should be renewed before their actual failure involves adjacent parts in considerable magnitude. A record of these inspections makes a good basis for determining the quantity and kind of renewal parts that should be kept on hand.

A guide for determining the normal yearly renewal parts requirements is desirable. To evaluate each factor entering into the problem, however, is not practical on account of their irregular variation. The size of the unit, the average rating, the duration of banked periods, the fuel used, the character of the load, the degree of skilled operation—all have a marked influence on maintenance. Any standard, then, must necessarily represent a composite empirical figure drawn from the average of a large number of cases. To many plants it will apply exactly. For others it will be much too high and for some it will be much too low.

A study of the problem indicates that the normal yearly renewal parts required is best expressed as a function of the tons of coal consumed. Although the graph is not actually a straight line, it is believed that the curves shown in Fig. 1 represent as accurately as possible the average values encountered in the average plant. Incidentally, the difference between the overfeed and the underfeed curve may be accounted for by the increased cooling effect of the forced draft.

Renewal parts fall naturally into two classes—plain castings and machined parts. Many of the plain castings are exposed directly to the fire and accordingly are renewed oftener than machined parts. On the other hand, machined parts are more expensive than plain castings. A one-year period is not sufficient to show the relative value of each used. A longer period must be used. It should be not less than three years—the longer the better.

From a study of the flow of renewal parts business through the works, the average division is as shown in Fig. 2.

Buying Renewal Parts from the Local Foundry

In some instances renewal parts are being purchased from the "foundry around the corner." It can supply only copies of parts in the plain casting class, has no interest whatsoever in the performance of the equipment and is anxious only to secure so many pounds of casting business for the foundry. It does not supply any renewal parts of the machined parts class because it would have to accept this class of business at a loss. Of course, parts purchased in this manner are obtained somewhat cheaper than from the manufacturer of the equipment.

Every plant owner is vitally interested in keeping operating costs down to a minimum. Shopping around for cheap parts of the plain casting class appeals to him as a practical way of working toward this end. Perhaps he has found that when all renewal parts are purchased from the stoker manufacturer, they cost him ten cents a pound. Compared to this, castings from the local foundry at five cents per pound look like a mighty attractive proposition. What then, is the most economical policy?

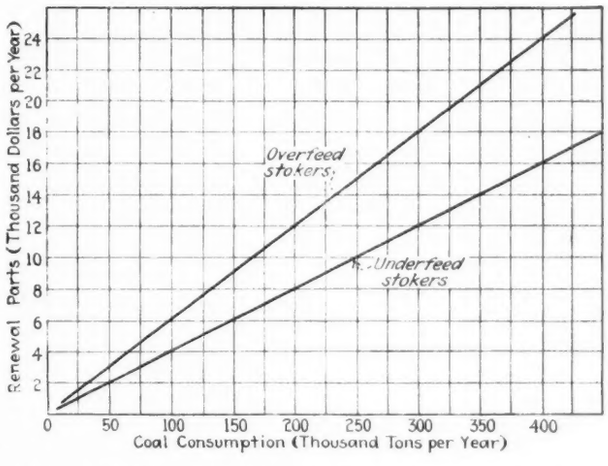


Fig. 1—Normal yearly renewal parts for overfeed and underfeed stokers

Any purchasing policy, to be sound, must be funda-

mentally correct from the economic point of view. The stoker manufacturer has established a plant for the manufacture of renewal parts both of the plain casting class and of the machined parts class. The overhead production costs of the latter class are extremely high, owing to special machine set-ups, engineering manufacturing data and special jigs and fixtures required for their fabrication. The overhead production costs for the plain castings class is comparatively low. The stoker manufacturer depends upon a good volume of this class of renewal parts to enable him to keep down the selling price on the machined parts. Suppose that users diverted this plain castings business from the stoker manufacturer's plant by adopting the policy of shopping around for cheap castings. This would result in an unbalanced shop load with the consequent pyramiding of overhead expense and production costs. It can be readily seen that this economic factor alone would force a marked increase in the selling price of the machined parts if the business is to be kept on a substantial basis. From a knowledge of the production problem the resulting extra cost to the user would more than offset the apparent saving to be made by buying plain castings from the local foundry.

It should be borne in mind that the control over this factor is entirely in the hands of the stoker user and not in the hands of the stoker manufacturer.

Fair Play for the Stoker Manufacturer

Furthermore, from the viewpoint of "fair play" the stoker manufacturer is entitled to the renewal parts business. The local foundry has made no contribution to the science of combustion. It is not fair to the stoker manufacturer to expect him to incur all the expense of research and engineering to evolve the correct design of parts and then have the user turn the design over to the local foundry for cheaper production. Such a policy

Plain Castings (Thousand Dollars per Year)
0 1 2 3 4 5 6 7 8 9 10 11 12
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
Renewal Parts (Thousand Dollars per Year)

Fig. 2—Relation of renewed plain castings to total renewal parts

is a most potent method of killing development in the combustion field.

Aside from the considerations mentioned, there are other reasons which justify the policy of purchasing renewal parts from the manufacturer. Any improvements made from time to time in the design are automatically furnished the user. Frequently these are of great importance from the operator's point of view.

The use of preheated air for combustion imposes severe conditions of service which the stoker parts are called upon to withstand. Under this circumstance the quality of material used, the character of their design and the correctness of their fit become not only important but vital factors in the control of maintenance. The stoker manufacturer through years of study and experience is best qualified to supply parts in which these factors have been properly incorporated.

A plant devoted solely to the manufacture of stoker parts is inherently more capable of furnishing parts of

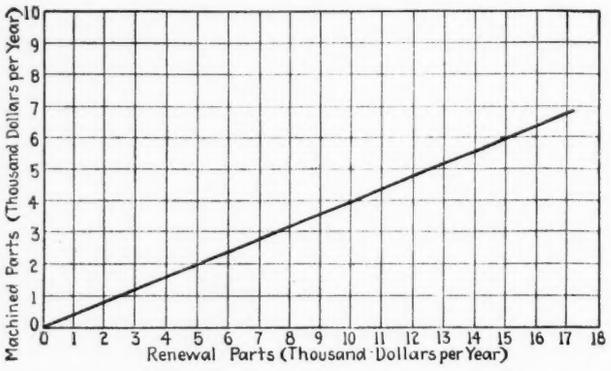

Machined Parts (Thousand Dollars per Year)
0 1 2 3 4 5 6 7 8 9 10
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
Renewal Parts (Thousand Dollars per Year)

Fig. 3—Relation of renewal machined parts to total renewal parts

a uniform material and fit than a jobbing foundry. The stoker manufacturer is keenly interested in controlling the analysis of the iron to produce heat-resisting castings. He is fully aware that this grade of iron is not easy to machine. On the other hand, the jobbing foundry supplying a diversified trade gives little consideration to the analysis of the iron except to secure clean looking castings, soft and easy to machine. The appearance of these castings is often very misleading to a purchaser if he intends to subject them to high temperatures.

Finally, the fit of the castings is an exceedingly important factor in keeping down maintenance costs. Expensive mistakes frequently have had their origin in an apparently insignificant variation in a dimension. This is natural and typical of parts purchased from a jobbing foundry since they may have no knowledge of the character and value of tolerances used. Even a variation in foundry methods is frequently sufficient to make parts unserviceable.

In a Recent Report of the N.E.L.A. Electrical Apparatus Committee, on the storage, handling, treatment and testing of insulation oil it is stated that permanent facilities for the storage and treatment of insulating oils for electrical equipment are provided by more companies at power stations than at central reconditioning plants, and by considerably less than either at local substation reconditioning plants. At power stations the decision to install permanent oil-handling facilities is based in most cases on the importance of the station. At the substations, however, the amount of oil in use and the importance of the substation are equally important factors in determining whether such permanent facilities shall be installed. The total quantity of transformer and circuit-breaker oil in service varies with the size of the power stations and the substations. The maximum quantity of transformer oil reported used at power stations was 550,000 gal. and at substations 950,000 gal. The maximum quantity of circuit-breaker oil reported in service at the power stations was 322,000 gal. and at substations, 304,000 gallons.

How to Operate System Reserve Capacity at Lowest Cost

By S. Logan Kerr
Research Engineer
I. P. Morris & De La Vergne, Inc.

THE use of hydro-electric units for synchronous condenser operation has become quite popular in the last few years and offers an inexpensive method of utilizing existing equipment for voltage and power-factor correction when it is not required for power-generating purposes. In addition to the use of hydro-electric units for these purposes another interesting application is to float extra units on the line. This provides the necessary system reserve capacity in parallel with the line and available for immediate service when required.

The operation of the units for this service is practically the same as for power-factor correction, the only difference being the adjustment of the excitation to have the unit floating rather than carrying an appreciable amount of wattless current. The governor is adjusted to hold the gates closed until the frequency drops appreciably below normal. At this time the flyballs will open the turbine gates and make the units deliver power instead of absorbing it from the system, or automatic trips can be used if the local conditions require.

It is essential to have the runner properly vented so that it is rotating in air and not acting as a pump drawing a large amount of power from the line to drive it. Too great stress cannot be laid on the proper venting of the units, since tests indicate that the power required to drive a unit without venting is from ten to twenty times that required if the runner is rotating in air. The turbine casing is filled with water under pressure, and for low-head units no difficulty will be experienced due to the guide-vane leakage, as this should not amount to more than one per cent of the full-load quantity. On high-head units the leakage may be considerable, and special provision must be made to avoid this and prevent the film of water passing between the guide vanes and the distributor plates from cutting the inflow edge of the runner buckets.

One effective method of reducing this leakage has been to close the penstock valve and prime the casing through a bypass with only enough area to maintain a pressure of five or ten pounds in the casing with the turbine gates closed. To have a unit deliver power automatically with a drop in frequency when such an arrangement is used, it is necessary to provide special control to open the penstock valve before the turbine gates are opened, thus insuring full penstock pressure on the turbine in a short time. Several plants of this type have been installed or are under construction, and the scheme does not present any appreciable difficulty in either design or operation.

The cost of having more units in service than necessary for economic loading requirements will cause large losses. By using the reserve units as synchronous condensers in parallel with the system, arranged to pick up load automatically, a satisfactory solution to the problem is provided.

Taking a specific instance with 20,000-kw. units, under a head of 70 ft., the normal full-load discharge is 3,930 sec.-ft. per unit. To operate one of these units at speed-no-load requires 670 sec.-ft. or 17 per cent of full-load discharge. From actual tests the average efficiency over a wide range of operation indicates that approximately five kilowatts are obtained per second-foot discharge when the units are operated in the upper third of their capacity. Assume that an output of approximately 18,000 kw. is required from the given station, but an additional reserve capacity of 20,000 kw is required in parallel with the system to take care of emergencies.

This would require at least two units in parallel on the line. If the load were divided equally between the two, they would require 2,030 sec.-ft. each, or a total of 4,060. This load could be carried on one unit using only 3,430 sec.-ft., a possible saving of 630 sec.-ft., assuming power at 5-kw. per sec.-ft. and 5 mills per kw.-hr., approximately 3,150 kw.-hr. for each hour of operation, or a loss of $15.75 per hour.

If this second unit was operated as a synchronous condenser floating on the line, 500 kw. would be required to drive it. Adding this to the demand on the station increases the output to 18,500 kw., which can be carried with 3,520 sec.-ft. plus the gate leakage on the second unit, amounting to 15 sec.-ft., or a total of 3,535 sec.-ft. A saving of 525 sec.-ft. is effected, representing approximately $13.12 per hour saving with this type of operation as against the plan where the output was divided equally between the two units operating at a less efficient point on their input-output curve. In one case 4.43 kw. would be obtained per second-foot, while in the other 5.10 kw. per second-foot would be secured.

This method of operation costs more than would be the case if the additional unit were not in service, but results in a considerable saving in the time required to place the additional capacity on the system when needed.

As the systems become more and more interconnected, the need of maintaining system reserve capacity is to some extent reduced, but during the morning peaks, the noon dips and the afternoon peaks hydro-electric units offer a convenient method of supplying large blocks of power on short notice and with a great deal of flexibility in operation. The actual time interval can be reduced to a minimum by the use of this scheme of synchronous condenser operation, for the units can be started up some appreciable time in advance of their requirements and be carried on the line at a small expense.

Right Out of the Plant

Duration of Peak Loads on Meter Charts

I NOTE from the April 23 number that there is some controversy concerning the duration of the peak load on a 75-hp. motor, a recording-instrument chart of which is shown in Fig. 1 on page 307 of the Feb. 19, 1929, number.

This misunderstading is apparently due to the chart speed having been omitted in the reproduction. The actual chart speed of this record is three inches per minute, one minute being represented by the distance between numerals 14 and 15 on the chart. The duration of the peak between 14 and 15 is, therefore, in the order of seven or eight seconds.

Schenectady, N. Y. E. J. WEHRLE,
Meter Department,
General Electric Company.

Molds for Hydraulic Leathers

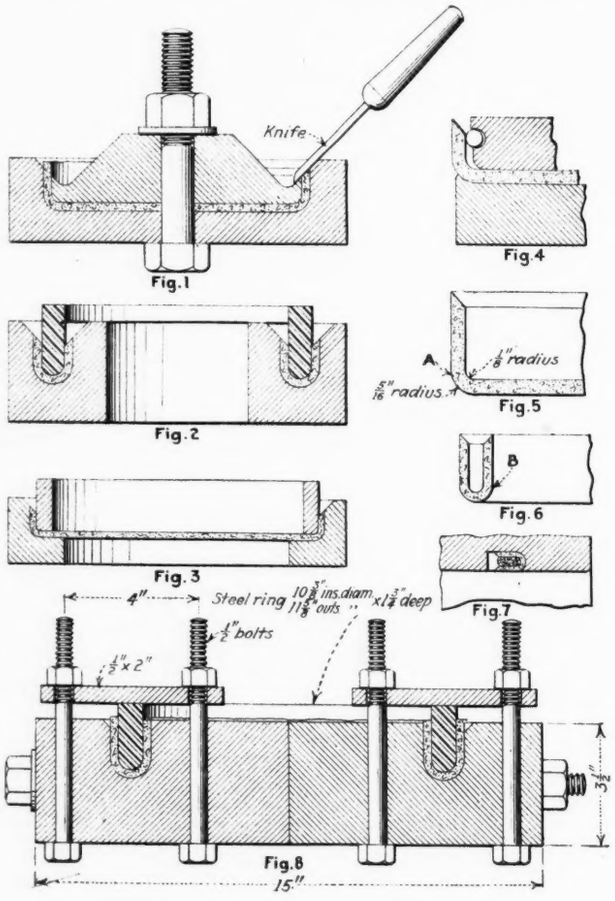
THERE is a difference of opinion among engineers as to whether the hair or flesh side should be the wearing surface of hydraulic leathers. Those of factory make more often have the hair side out, perhaps because of their better appearance. When made with the flesh side out, they are given a coat of special varnish, which serves to smooth the rough surface and act as a preservative.

There seems to be much that favors the flesh side being the wearing surface. It is softer than the hair side, and where a lubricant is necessary, as when used in air cylinders, it will retain the lubricant better than the hair side. Making the flesh side the wearing surface keeps the strong close-grained hair surface intact, thereby greatly prolonging the life of the leather. If the hair side is made the wearing surface, soon after it is worn through, the leather will become unserviceable.

For most purposes a good grade of oak-tanned single-leather belting about $\frac{3}{16}$ in. thick serves well for making hydraulic leathers. Soaking in cold or slightly warm water for 24 hours and soaping and working in the hands at intervals will make it soft enough to mold. The working edge of the leather is chamfered to make it lie snug to the cylinder wall or rod surface. The chamfer can be given the leather before it is placed in the mold or afterward in the lathe.

Figs. 1, 2 and 3 show the kinds of molds I have designed and made, so that the leathers can be chamfered while still in the mold and before they have become hard. The 45-deg. surfaces act as a guide for the trimming knife. The leathers should be left in the mold until dry. The drying can be speeded up by removing the male part of the mold and placing the leather in a warm place. If not needed immediately, the leathers can be given a coat of varnish and stored in a cool place. For intermittent service it is sometimes necessary to use an expander ring of some sort to keep the leather tight against the surface of the cylinder. Fig. 4 shows one type of expander ring made of hard-drawn brass wire.

Experience shows that cup leathers with comparatively short skirts last longer than those of usual length. The wear takes place at *A*, Fig. 5, in cup leathers, and at *B*, Fig. 6, in U-leathers. The longer the skirt the greater the surface exposed to pressure and the greater the strain at *A* and *B* when the leather is traveling. The total friction will also be greater. The U-leathers of some hydraulic presses are held in a groove formed in the cylinder wall near the outer end, as in Fig. 7. The leather must be slightly limp to allow of its being placed in the groove, and after it is in position a turn of flax packing of suitable size is placed inside the U-leather to insure the leather fitting closely to the ram before the pressure is applied.



Assembly and details of leather molds

I once had to make a U-leather for a 10-in. ram of a press that was urgently needed. For a mold I bolted together two pieces of maple $3\frac{1}{2}$x$7\frac{1}{2}$x15 in. to form a square 15x15x$3\frac{1}{2}$ in. While the groove was being formed in the lathe, the blacksmith forged a ring out of $\frac{3}{4}$x2-in. mild steel bar.

The ring was machined all over in the lathe $11\frac{5}{8}$ in. O.D., $10\frac{3}{8}$ in. I.D. and $1\frac{3}{4}$ in. deep, the leather being $\frac{3}{16}$ in. thick. For a leather I took a piece of double leather belting and, using one ply, cut out of it a ring 14 in. O.D. by 8 in. I.D. This ring had all the glue scraped off and was given the usual soaking, then pressed so as to leave the flesh side out. Fig. 8 is a section of the mold. E. J. JORDAN.

Long Beach, Calif.

Sun Spots a Factor in Predicting Stream Flow for Power Generation

THE ability to predict water supply for hydro-electric plants or for any other purpose, with reasonable accuracy, as outlined by A. Streiff in the April 16 and 30 numbers, is of great importance from an economic point of view. Power stations, to be successful, must give satisfactory service to the consumers and be profitable to the owners. So long as the flow of water in our streams and its distribution through the months and years is regarded as an unpredictable quantity, the production of water power is largely a hazardous proposition the success of which depends to a considerable extent upon the workings of the laws of chance and the assurance or, more often, the hope that the law of averages will prove in its favor.

Many who have struggled with the problems of hydrology and natural phenomena have come to the conclusion that they do not occur by chance, but are governed by laws. That their vagaries have remained mysteries since the earliest times is no reason for not attempting their solution, aided by the knowledge of past and present generations and the greatly improved analytical and mathematical tools of the present age. I am strongly of the opinion that the greater part, if not practically all, of the mystery and uncertainty supposedly inherent in the weather, hydrology and other natural phenomena may be made to yield before the assaults of the "Educated Imagination," reinforced by the refined and improved research tools that are now available or are capable of being developed.

The work of Mr. Streiff constitutes an interesting and valuable piece of research in this field. In practical use for forecasting, it is understood that the element of personal judgment in extending the cyclic curve of runoff is largely called into play. That this is the case is evident when it is recalled that the sunspot curve is not always parallel or in phase with the runoff curve. It may be directly opposite in phase or displaced by some time interval.

Mr. Streiff has been successful in predicting the annual runoff in the Michigan area for several years past, with close results. Others who have attempted to use the method report varying degrees of correspondence between the predicted and the actual runoffs. How much the element of trained judgment, backed by extended experience, may have been responsible for these results is, of course, problematical.

Mr. Streiff has said that his researches had indicated that it is not certain that a dependable relation between the sunspot cycles and short time (monthly or seasonal) runoffs exists.

A. H. Davison, hydraulic engineer, International Paper & Power Company, Glens Falls, N. Y., has analyzed the flow of the Hudson at Spiers Falls, using the accumulated flows at the end of each calendar month for a period of years, and finds a cycle of variation similar to that of Mr. Streiff. Mr. Davison, however, divided the year into low, medium and high-stage calendar months, beginning with the first of January, and he concludes that the runoff from Jan. 1 to May 1 is close to a constant percentage for that of the calendar year. He also finds that the low- and medium-stage periods yield approximately constant percentages of the total yearly runoff.

By estimating the annual runoff by means of Mr. Streiff's method and applying Mr. Davison's subdivisions of the predicted flow, close estimates of totals for these groups of high-, medium- and low-flow months should be possible.

John F. Partridge, of the California-Oregon Power Company, Medford, Ore., in *Electrical West*, Dec. 1, 1928, pages 321 to 325, described a method somewhat similar to Mr. Davison's, used in predicting stream flow in western Oregon. He makes use of mass curves of precipitation beginning Sept. 1, and of runoff beginning Oct. 1, and also "indices of wetness" and of "runoff." The latter are used in checking the relations between rainfall and runoff. He also uses a graph of accumulated departures of indices of wetness from the mean, which constitutes a graph of the "trend of wetness" and bears a close resemblance to both Mr. Streiff's and Mr. Davison's cyclic curves.

These methods may be found to supplement that of Streiff, in that future experience and research may show that they are interdependent, and that the annual runoff computed by his method may be reliably subdivided into seasonal or monthly runoffs by one of the others. If such should prove to be the case, the value to hydro-electric operating companies is obviously great. If predictions can be made, accurate within 10 or even 20 per cent, they will be of much greater value than the usual "guesstimates," which we are forced to rely on as the best possible predictions.

Steps are under way to test the validity of both Streiff's and Davison's theories in relation to the principal rivers of New York State in the near future. The results of this test should interest hydraulic engineers concerned with this problem.

There is much to be learned in this field. But the merest beginning has been made. Being convinced that runoff and other meteorological phenomena occur from definite natural causes and in accordance with definite natural laws, an interesting and fruitful field of research is opened to those possessing the necessary training and imagination for the task. An educated imagination is a prime essential, because the inter-relations of the various phenomena are often obscure and must be carefully thought out, theories formed and then proved or disproved by application to actual records. As a mass of theories and data accumulates, we shall find ourselves coming nearer and nearer to a full understanding of these phenomena and their workings, and we shall come nearer to being able to predict their occurrence with accuracy.

In order that progress may be positive and rapid, it is also essential that the workers in this, as in other fields, shall maintain constant and frequent touch with one another, frequently comparing notes and interchanging theories, data and results. The recently organized Engineering Research Committee of the National Electric Light Association, Dr. C. F. Hirshfeld, Detroit Edison Company, Detroit, Mich., chairman, offers an opportunity to centralize the information as to who is engaged in such research, as well as the character of work being done or undertaken, and through whom contacts may be made.

A central research committee on Stream Flow and Related Phenomena, which might be formed under the jurisdiction of the American Society of Civil Engineers, for instance, might prove the best means of giving impetus to the concentrated study of this problem and getting the quickest and best results.

Radio and aircraft have provided the practical means

for instant communication and quick and easy access to the polar regions, where it is certain that the disturbances that affect precipitation and other weather phenomena originate. It is reasonable to suppose that were these regions dotted with meteorological stations reporting daily, we should soon accumulate data which, when co-ordinated with those of our own and other parts of the world and studied by qualified meteorologists and engineers, might yield up the secret as to what we might expect with certainty for some weeks or months in advance. It is to be hoped that the installation of such a weather network and the beginning of such co-ordinated and co-operative studies will not long be delayed.

Run-of-river plants must make the best use of water as and when it reaches the dam. Advance knowledge of the expected peak flow and its subsequent rate of decrease, even if known but a few hours prior to the peak, will often give the operator of an interconnected system sufficient knowledge to enable him to dispose of the available energy, thus turning a considerable waste into a profit.

I have derived some interesting and valuable but as yet unpublished relations between the shapes of typical river hydrographs following a peak or rise and the coincident calendar dates and temperatures or climatic conditions. Further, I have derived an imperfect but promising relation between average rainfall on a watershed and the resulting flood peak. The results point to the possibility of unraveling and solving this interesting and important problem by giving more thought to the underlying natural conditions and evaluating their individual and combined effect on the final result.

Each of these different means of forecasting therefore fills a separate niche in the quest of definite foreknowledge of the rise and fall of rivers, and they are supplementary to one another. With the experience and technique gained through constant application and analysis, both of the results obtained and their apparent or probable causes, and the co-operative exchange of ideas and information between those working with them, the inter-relation between rainfall and runoff and other natural phenomena will become better and better understood and forecasting will assume more and more the aspect of an exact science.

BYRON E. WHITE, General Engineer,
Utica, N. Y. Utica Gas & Electric Company.

Forecasting Water Supply

I HAVE read with interest the articles in the April 16 and 30 numbers on forecasting water supply and the relation between solar cycles, rainfall and runoff. We have records back to 1912 on the Kaministikwia River, which had extreme flood peaks in 1916 and 1926 and 1927. In each case the flood year was preceded by a wet fall, with saturated ground condition, that is, in 1916 and 1926.

Our record somewhat parallels the Winnipeg River, with sharper variations. The latter, no doubt, is due to our smaller watershed, 2,800 square miles as against 53,000 for the Winnipeg River, with its larger tributary lakes and ground storage, retarded flow and more even plateau.

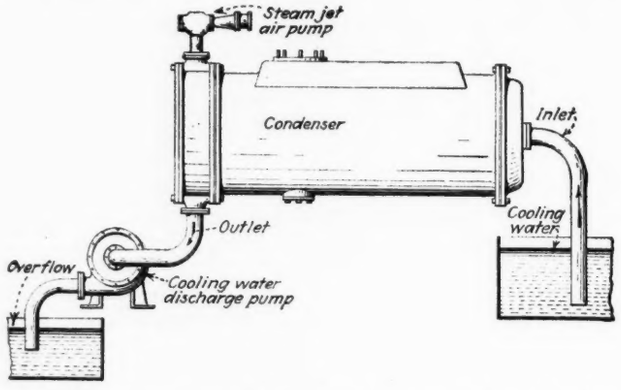
Each month we determine our watershed runoff, precipitation and ground condition. From study of previous years we then endeavor to find the nearest parallel year and period. We have also used the Lake Superior lake-level chart, extending back to 1860, as indicating our probable place in the longer term cycle, beyond the range of our own records.

Fort William, Ont. W. L. BIRD, *Vice-President*,
Kaministiquia Power Company, Ltd.

Why Not Draw Instead of Force the Circulating Water Through the Condenser?

I HAVE read, with interest, the "Questions for Our Readers" columns on Page 287 in the Feb. 12 number and wish to make the following comments:

Keeping condensers tight is one of the most important problems in the modern power plant operating at high pressure. It is a well-known fact that the operation of a high-pressure boiler requires a pure feed water, which



Proposed arrangement for drawing instead of forcing cooling water through condenser

has resulted in the frequent application of evaporators to produce the makeup feed. It is customary to require the manufacturers of this apparatus to guarantee the chemical purity of the distilled water.

However, the use of even the purest makeup will be of little consequence if the condensate is being constantly polluted by condenser leakage.

Modern practice has proved that it is feasible to keep condenser-tube joints tight at both ends by expanding the tubes into the plates. Nevertheless, it is desirable to reduce the cooling-water pressure as much as possible.

The method illustrated in your sketch, in the question referred to, is, however, likely to lead into difficulties. To bring about a barometric discharge it will be necessary to set the condenser at a high elevation, which will naturally increase the cost of the foundations, since it will not be safe to set the turbine lower than the highest point of the condenser. This is necessary to safeguard against the possibility of flooding. Perhaps this danger could be avoided by providing a suitable U-seal in the turbine exhaust connection, but this will make an unduly long steam path, with added joints.

It will, therefore, be advisable to secure the lower pressure by other means. For instance, the cooling water could be drawn into, instead of being forced through, the tubes. This will necessitate the priming of the circulating system by means of an air pump, which must be connected to the highest point. Such an installation would, in my opinion, be simple and practicable.

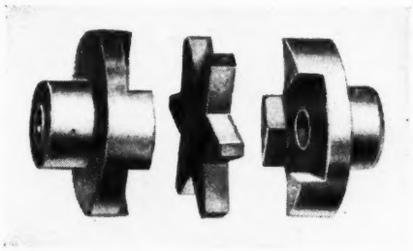
Berlin, Germany. W. GRINBERG.

What's New in Plant Equipment

HOW THE MANUFACTURER CONTRIBUTES TO THE JOB OF GENERATING TRANSMITTING AND APPLYING THE POWER SERVICES

Star Flexible Coupling

ONLY three parts are used in the star flexible coupling developed by the W. A. Jones Foundry & Machine Company, 4401 West Roosevelt Road, Chicago, Ill. The coupling has



Rubber disks fit between lugs on coupling flanges

two flanged semi-steel castings with three projecting lugs on each half, which engage a central star-shaped rubber disk. The slope of the lugs is such that the load on the disk is in compression over a large surface. The tendency, therefore, is to compress the rubber disk toward the center.

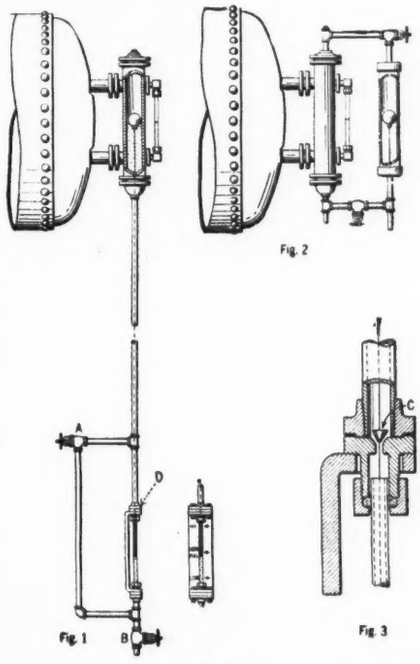
Three sizes of the coupling are available. They are Nos. $\frac{5}{8}$, 1 and $1\frac{3}{8}$, having corresponding bores in inches. The diameters are $2\frac{1}{2}$, $3\frac{1}{2}$ and $4\frac{1}{2}$ in., and the over-all widths are $2\frac{5}{16}$, $3\frac{3}{16}$ and $4\frac{1}{16}$ in., respectively. These couplings are intended for a maximum speed of 2,000 r.p.m. The weights are 2, $3\frac{1}{2}$ and 8 lb. respectively.

Mechanical Boiler Water-Level Indicator

A SIMPLE device that permits the placing of water-level indicators at any desirable location or elevation for ready observance by the operator has been recently brought out by Combustion Engineering Corporation, New York City.

Fig. 1 shows how the water-level indicator operates. The usual water column is shown connected to the boiler drum. Inside the column is a non-corrosive float suitable for the maximum working pressure for which the boiler is designed. This float is connected by means of a non-corrosive wire extending downward through a small pipe to an indicator in the water glass. The circuit around this indicator is filled with cold water which has no corrosive effect on the glass.

The indicator is so adjusted that when the float in the water column on the drum is in its normal position, the indicator within the lower glass is also in the center of the glass or at normal level position. The indicator consequently fluctuates correspondingly with the up and down



Arrangement of C-E water-level indicator

movement of the water-column float at the drum.

It is possible to locate the indicator to meet any local conditions. If it is not practical to drop the indicator vertically from the water column on the drum, arrangements are made whereby the water column can be placed inside the drum, or, as shown in Fig. 2, horizontal extensions of any length can be made to bring the water column to any desired position.

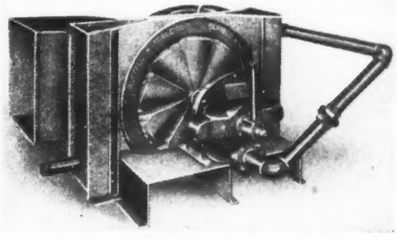
To prevent leakage in case the water glass should be broken, an automatic shutoff valve is placed in the fitting *D* directly above the glass. This conical valve is attached to the wire between the water column and the water-level indicator in such a position, as shown in the detail Fig. 3, that when the glass is broken and the water released, the valve *C* is forced into the valve seat, thus closing the cold-water circuit.

After a new glass has been put in place, valve *A*, Fig. 1, is opened, valve *B* remaining closed, thus equalizing the pressure above and below the valve. The float then returns to the position of the water level and in so doing, lifts the valve *C*, which allows the water to fill the indicator gage glass again. Because the device operates in a cold water circuit, the usual round glass is suitable for high pressures.

The indicator can be installed in conjunction with, or separate from, the regular high- and low-alarm signal system.

Steam-Turbine Drive for Unit-Heater Blower

A SMALL steam turbine for use with unit heaters, in which the turbine drives the fan to circulate the air over the coils and the exhaust steam from the turbine is used as the heating medium in the coils, was introduced recently by the Murray



Arrangement of turbine drive on unit heater

Iron Works Company, Burlington, Iowa.

The turbine is generally so arranged that it will consume for power about two-thirds of the steam required for the heating element, and the remaining one-third of the required steam is bypassed through the turbine by means of a valve on the turbine housing. A separate

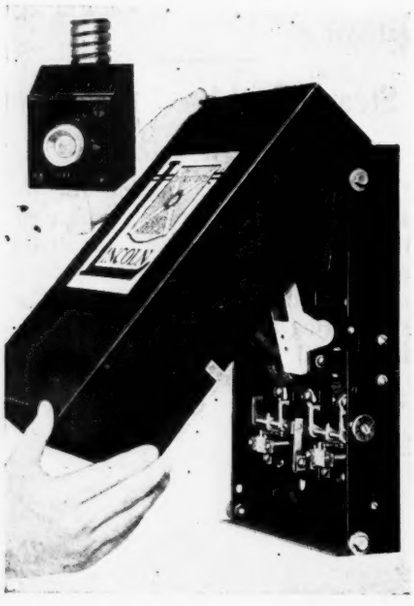
speed control is also provided on the turbine.

In the unit shown, the exhaust from the turbine is piped to the top of the heater coil and the condensation is taken off on the opposite side near the bottom.

Across-the-Line Safety Starter

EASE of installation, ready accessibility to all operating parts and improved construction are some of the advantages claimed for the new across-the-line starter announced by the Lincoln Electric Company, Cleveland, Ohio. The safety push button shown in the upper left hand corner is standard equipment with the new starter.

A cover of the drop-hinge type incloses the entire mechanism and permits installation of starters closely grouped, two inches clearance between starter boxes being ample for accessibility. Releasing two other screws permits the contactor panel to swing out, thus making lead contacts easily accessible.



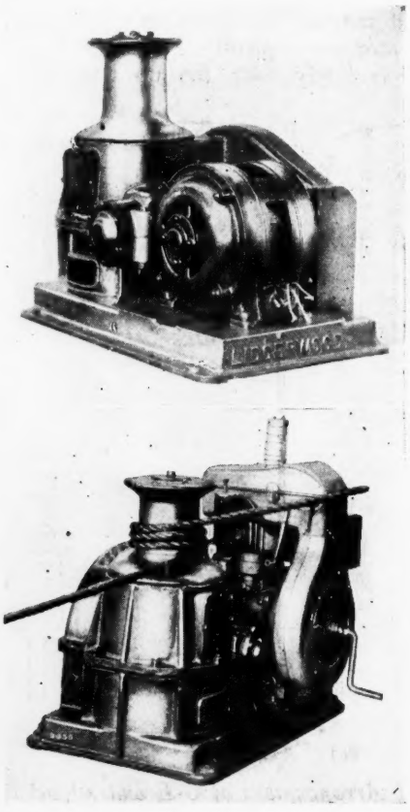
Across-the-line starter with push-button safety switch

It is pointed out by the manufacturer that long life is assured to the contact points by the wiping action, which prevents pitting, and by the cadmium plated steel shields, which provide an instaneous thermal and magnetic quench for the arcs. The relay armature has a cushion action and is provided with replaceable bronze bearings and is actuated by a coiled spring.

The safety push button (described in the Feb. 5 number) provides an additional safety factor in that the red stop button encircles and protects the green start button, so that it is impossible to close the starting circuit unintentionally. The push button can be mounted on the side of the starter box or arranged for remote control.

Motor and Engine-Driven Capstans in Five Sizes

FOR spotting coal cars and other uses around power and industrial plants, the Lidgerwood Manufacturing Company, Elizabeth, N. J., has brought out a vertical capstan in the motor and gasoline-engine-driven types illustrated.



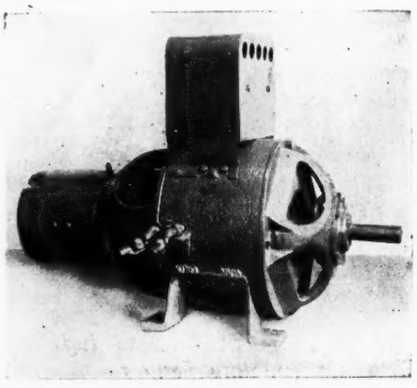
Motor- and engine-driven capstan

Compactness of design, reducing the space requirements to 25x34 in., is a feature of the new unit. It has been made a standard type and is available in five sizes: 5- and 7½-hp., alternating current, 5- and 7½-hp. direct-current, and a 6- to 8-hp. twin-cylinder air-cooled motor using either gasoline or kerosene for fuel.

As machines of this kind are frequently installed in exposed locations, the adoption of the air-cooled motor precludes the possibility of freezing in low-temperature weather. Anti-friction bearings are used and both the motor and engine-driven types are of weathertight construction.

Welding Generator for Belted or Coupled Service

A NEW design 200-ampere generator that is not provided with a driving unit has been recently added to the line of arc-welding equipment put out by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. The new unit is for use in isolated places where electric power is not available and where driving power such as gasoline engines, steam engines, lineshafting, etc., is already in use.



Generator with coupled exciter and control unit

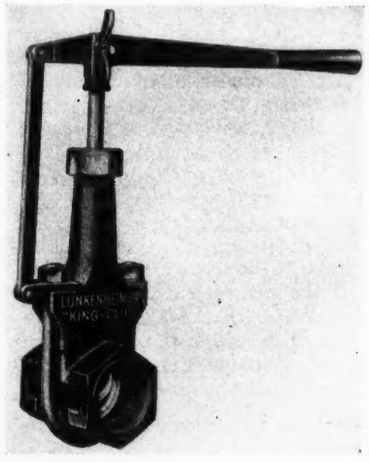
The complete unit consists of a special constant-current type-SK welding generator with coupled exciter overhung from the generator bracket, control panel and reactor. The generator is differentially compound-wound and designed for a single operator. The constant- current variable-voltage characteristics of the generator, together with the separately excited feature, tends to insure a steady and penetrating arc. Variations in arc length or intensity are automatically compensated for by instantaneous changes in the generator voltage.

The control for the generator is mounted on top of the frame and protected by a sheet-metal cabinet. The control consists of a voltmeter, ammeter and a single-dial field rheostat for adjusting welding current over the entire current range. The generator has a welding range from 60 to 250 amperes and requires a driving unit whose maximum rating is: Motor, 10 hp.; lineshaft, 15 and gas engines 20 horsepower.

New Line of Gate Valves in Screw and Quick-Operating Types

A NEW line of gate valves designated the "King-Clip," for use on steam, oil, gas, air, water and gasoline lines, has been developed by The Lunkenheimer Company, Cincinnati, Ohio.

Three designs are included in the new line: Rising-stem inside-screw, outside-screw-and-yoke and quick-operating. All types are available in iron-body bronze-mounted and all-iron patterns, with screw or flanged ends. In each type the bonnet is secured to the body by a steel U-clip as shown. This construction facilitates dismantling the valve for cleaning or inspection and adds strength and rigidity to the body. Screwed stuffing-box nut is used in valves up to 3-in.;



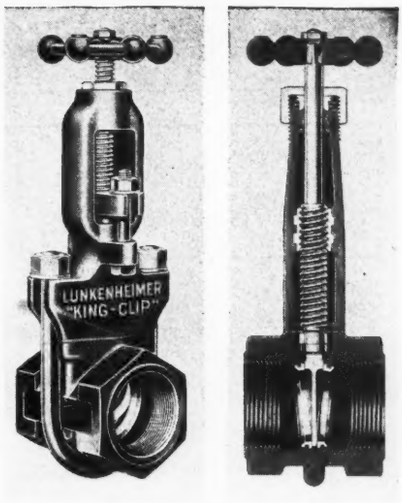
Quick-operating valve

sizes 1- to 3-in. have gland follower. A bolted iron gland is used in 3½- and 4-in. valves.

The disk in the new line is sharply tapered, making the valve also adaptable for handling heavily impregnated fluids. The quick-operating sliding-stem patterns are of similar material construction to the inside-screw patterns except that the handwheel is replaced with a lever attachment which permits quick operation.

In the all-iron patterns, all parts except the bronze bushing in outside-screw-and-yoke-valves are made of ferrous metals. All-iron valves are for use in handling solutions that attack bronze but not iron. Sizes up to 2-in. have permanently rolled-in steel seat rings; larger sizes have integral seats.

Pressure ratings of the "King-Clip" gate valves are: Screw ends ¼ to 2 in. inclusive, 150 lb. working steam pressure, 225 lb. gas or liquid pressure; screw ends 2½ to 4 in. inclusive and flanged ends 1½ to 4 in. inclusive, 125 lb. working steam pressure, 175 lb. gas or liquid pressure.



Outside-screw-and-yoke, and rising-stem inside-screw valves

Plastic Metallic Packing in Four Grades

A NEW line of plastic metallic packings in four grades is announced by the Magnolia Metal Company, 75 West St., New York City. The packing is designed for use with practically all types of machines, whether rotary or reciprocating, and with high and low pressures and temperatures.

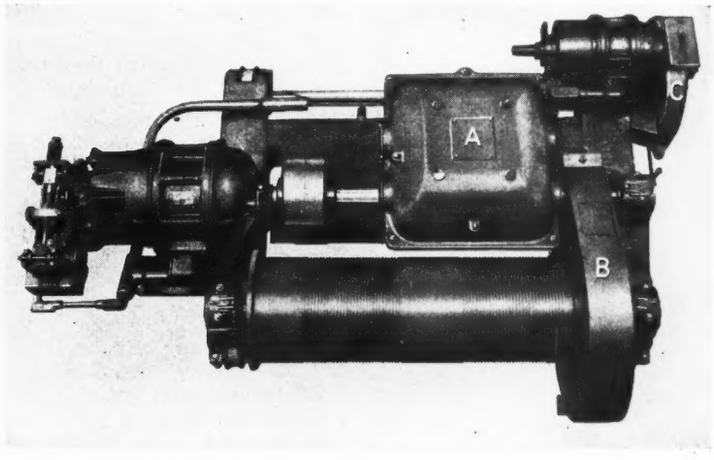
Grade A, Yellow Label, is for general utility; temperature range, 75 to 350 deg.; on concentrated acids up to 150 deg., except nitric and sulphuric; also suited for water, corrosive chemicals, ammonia gas, steam, compressed air and alkali. Grade B, Green Label is for temperatures ranging from zero to 100 deg.; suitable for refrigeration and brine pumps, cold-water pumps and dilute salt or alkali. Grade C, Red Label, is for high temperatures and pressures, ranging from 150 to 600 deg. and up to a pressure of 200 lb. of superheated steam; also suitable for hot gases, hot water and hot concentrated hydrochloric acid, phosphoric acid and hydrofluoric acid. Grade D, Blue Label, is for a temperature range from zero to 220 deg., and is suited for coal-tar derivatives, gasoline, benzol, kerosene, and oils.

The packing is put up in three sizes, 2½-, 5- and 10-lb. cans.

Improved Crane Trolley Design

IN THE new trolley design brought out by Shephard Niles Crane & Hoist Corporation, Montour Falls, N. Y., all the operating mechanism is totally inclosed. The high-speed reduction gear between the hoisting motor and cable drum, as well as the load brake and principal bearings, are inclosed in the casing *A*.

The final, or slow-speed, reduction to the cable drum is inclosed with a cover *B*, and the reduction gear drive from the trolley motor is protected with a cover *C*. Small removable plates are provided on the casings *B* and *C* to facilitate inspection. With this construction all gears are adequately protected from dirt and the high-speed gears and load brake are maintained in proper alignment.



Crane trolley with inclosed gears

FROM AMONG THE READERS'

Conducted
By
L. H. Morrison

ECONOMY OF A STEAM ENGINE—*How is the economy of a steam engine expressed? What type is the most economical?* H. B. J.

The economy is usually expressed in pounds of steam per horsepower-hour or per killowatt-hour. The uniflow engine is considered the most economical, although triple-expansion condensing engines have shown a better economy.

COMPRESSOR CONTROL—*What is the use of a compressor governor or control?* R. P.

Some compressors have a control such that when the air receiver pressure goes above a predetermined value, the control lifts the compressor suction valves so that no air is compressed. Other controls change the speed of the driving engine. Both save power, in that the compressed air is not wasted through the relief valve.

SIZE OF SAFETY VALVE—*How would you know if the safety valve was large enough without figuring its capacity?* A. B.

If the safety valve permits the relief of the boiler when the latter is forced, without a rise in pressure, obviously the valve is ample. However, it is better to consult the A.S.M.E. Boiler Code and see if the size is correct for the boiler capacity.

EXCESSIVE HYDROSTATIC PRESSURE—*A 60-in. x 16-ft. h.r.t. boiler with $\frac{5}{16}$-in. plate and $\frac{13}{16}$-in. rivet holes pitched 2.7-in. in the longitudinal seams, was built for 100 lb. working pressure, with a factor of safety of 4. In making the hydrostatic test prior to the visit of the inspector, there was considerable leakage at the seams. After calking the seams and rivets, the hydrostatic test was applied again. The boilermaker, in order to satisfy himself fully that the calking was secure, put a hydrostatic pressure of 220 lb. on the boiler and found everything tight.*

On the inspector's arrival he was informed what had happened. How can he find the new working pressure? The modulus of E = 30,000,000 and the elastic limit 30,000 lb.; assume that any stretch in the plate is limited to one-half the diameter of each of the outer rows of holes (or equaling a total of one rivet hole diameter). J. J. C.

The double-riveted lap seam in a $\frac{5}{16}$-in. plate, $\frac{13}{16}$-in. rivet hole, 2.7-in. pitch, would have an efficiency of 70 per cent. Using the formula for determining the safe working pressure, but substituting the elastic limit of the steel instead of the tensile strength, and omitting the factor of safety, we have $\frac{5}{16} \times 30{,}000 \times 0.70 \div 30 = 218.4$ lb. pressure. In other words, the elastic limit of the material is passed when the boiler is subjected to a pressure of 218 lb. per sq.in.

Accordingly, if the boiler has been subjected to 220 lb. pressure, the elastic limit has been exceeded and the assumption is that a permanent set has taken place, or in other words, the steel has been stretched to its yield point.

The stretch in the plate varies directly as the stress, so assuming the stress to be 30,000 lb. per sq.in. and the modulus of elasticity is taken as 30,000,000, the former divided by the latter gives 0.001 in. as the amount the sheet has stretched due to the hydrostatic test.

According to the question the stretch in the plate takes place along the line of the outer row of rivet holes, that line having a width equal to one-half the diameter of the rivet hole. The cross-sectional area of the plate at this section was the thickness $\times \frac{1}{2}$ diameter, or 0.1269 sq.in.

After the sheet has stretched 0.001 in., the width of this line, instead of being 0.40625, is 0.40725 in. As the amount of metal remains the same, the thickness has decreased an amount found by dividing the original area by the new width of the section, which gives us 0.3117 in. as the thickness of the metal after it is stretched. This thickness, instead of the original thickness, 0.3125 in., should be used as the thickness of the plate in the calculations to determine the safe working pressure on the boiler.

However, this question appears to have originated in Massachusetts, where trick questions are not unusual. Paragraph 1, section 6, part 2, page 13, Steam Boiler Rules of the Department of Public Safety of the Commonwealth of Massachusetts, provides that the hydrostatic test applied to a boiler shall not be less than 125 per cent, nor more than 150 per cent of the maximum allowable working pressure. Accordingly, if the inspector has knowledge of the application of a hydrostatic test in excess of 150 per cent of the working pressure, he could not accept the boiler as meeting the requirements of the State of Massachusetts.

Likewise, if the boiler were to be built in accordance with the requirements of the A.S.M.E. Boiler Code, the inspector could not accept it if he had knowledge of the application of the hydrostatic test referred to in the question. Paragraph P-329 of the Code provides for a hydrostatic test of one and one-half times the maximum allowable working pressure, and further provides that the pressure shall be under proper control so that in no case shall the required test pressure be exceeded by more than 6 per cent. In view of this fact the inspector would have no choice but to reject the boiler.

In the question the elastic limit and not the yield point is referred to, and in the analysis it has been assumed that the yield point was passed, for frequently the terms "elastic limit" and "yield point" are used synonymously. If the yield point was not passed when the hydrostatic test of 220 lb. was applied, there should be no permanent stretch and the thickness of the material should not be decreased. Therefore, the standard formula for determining safe working pressure would apply without any reduction in thickness.

In general, the restriction upon the amount of hydrostatic pressure that may be applied under the various boiler codes is considered necessary, although in special cases where the test has been conducted under careful control, objects have been tested to the yield point and the safe working pressure established as 40 per cent of the yield pressure.

The maximum diameter of a boiler having double-riveted lap seams is 36 in. if the pressure exceeds 15 lb. per sq.in., so the 60-in. boiler would be limited to 15 lb. which is a further indication that the question is a catch one asked of engineers in examination.

CONTACTS ON VOLTAGE REGULATION STICK OPEN—*What caused the contacts of a vibrating-type regulator to stick open? This regulator operates for a day or two without any indication of instability and then without warning the contacts stick open, which of course reduces the voltage on the generators to a low value. I have been working on the regulator for two weeks but can find nothing to cause the trouble.* W. H. K.

The cause of the trouble is probably in the external resistor. It may be that it has become damaged in some way and one winding of the relay is getting an excess amount of current, or an open circuit may be in the winding going to the main contacts. It may be that the resistor in series with the control element is short-circuited, causing the main floating-lever contact to open. At any rate the trouble is probably due to either loose connections or the external resistor. It would be advisable to dismantle the resistor and see that the insulation is good on the tubes and not deteriorated, and that all connections are good. If the resistor is defective in any way or damaged, it would no doubt be advisable to replace it.

PROBLEMS

ANSWERS

from Our Readers

THE QUESTION

WHEN laying up the steam - heating system for the summer, should I fill our return tubular boiler with water or should it be drained and the manholes left open? Also, should I close the damper and firedoors or should these be left open to insure air circulation through the boiler?

A. A. C.

I HAVE tried all ways of preparing our two cross-drum water-tube boilers for their summer vacation, and I do not find that it makes much difference how you lay them up for such a short time—three or four months. I always have them thoroughly cleaned inside and outside, all ashes and soot removed, tubes turbined and everything as clean and dry as possible.

One year, after cleaning we filled one boiler full of water and left it full until wanted. The other one was opened up and left open with dampers open but furnace doors closed. After a period of four months the water was let out of the one that was filled, and upon examination of both boilers the one that had been filled with water looked the better. No rust nor corrosion was discovered, while several damp spots were found on the empty boiler. Since then I have the boilers filled with water.

When we opened the boiler that had the water in, we found that where any slight scale had been it was soft and easily removed with the hose. In the other boiler it was hard and dry and very difficult to remove. If a boiler is to remain idle for a long period, say a year or more, it is possible that the dry method would be preferable, but for a short period I would use water. It is possible that the condition of the water might make a difference in some localities, but I have used city water with no bad effects.

Detroit, Mich T. F. SLOW.

AFTER the inside is thoroughly cleaned, the boiler should be filled with water and then filled to overflowing with a low grade of mineral oil. The water then should be drawn off, leaving all parts of the interior coated with oil. Any water left in depressions then should be driven off with a light wood fire. As an additional precaution against rusting, place a small quantity of unslaked lime in the boiler before closing it up.

Thoroughly clean out the fire tubes and swab them with oil. Paint the outside of the flue sheets and plug the tube ends with waste. Boilers that are bricked in usually are protected from the weather, and their exterior surfaces will not need any further care than to protect them from moisture. Seal fire and ashpit doors tight; also seal the dampers with asbestos, cotton wool or other convenient filling and, if practicable, disconnect them from chimneys so that there will be no circulation of air to deposit moisture.

HERMAN SCHRAINOGEL.

Cincinnati, Ohio.

A WEEK or two before the heating season is over, put 10 to 25 pounds of sal soda into the boiler, according to its size. When through with the boiler raise steam to about 10 pounds, open the blowoff valve and empty the boiler. Remove all manhole or handhole covers; clean all mud and sediment that may be in bottom of boiler. Next wash down the inside of the boiler. Tubes, heads, shell and combustion chamber should be cleaned of all soot and the ashes removed from the grates and ashpit. Leave all manhole covers off; open the ashpit doors; close the tube doors and leave the damper open, which should insure an air circulation through boiler and keep it dry. In stoke holes that are damp and where boilers sweat, a pan of lime should be placed on the tubes inside of the boiler, also a pan on the grates, to absorb any moisture that may settle in the boiler.

Experience with boilers left partly or completely filled with water, indicate that corrosion will take place, small scabs or blisters of rust will form on the metal, which will cause it to pit.

Toronto, Canada. W. A. JACOBS,
Boiler Inspector.

I FIND that when laying up boilers for the summer, the following practice is advisable: Wash the boiler thoroughly, and remove all the water. Close all valves and other openings. Before closing the lower manhole, place a tray of unslaked lime in the boiler. Now seal the boiler, and leave it until ready to operate the next season. The unslaked lime takes up any moisture that happens to be in the boiler and it may be necessary to renew the supply of lime before the summer is over.

The firebox, combustion chamber, smokestack and other surfaces should be cleaned of all ashes, soot and other refuse, and the firedoors and other door openings kept closed.

I would not advocate the placing of oil in the boiler, for oil is extremely dangerous and should never be placed in the boiler, either by intention or accident. If water is left in the boiler, there is a chance for corrosion.

I would seal the firedoors, to prevent anyone from burning papers and other refuse in the firebox; considerable damage has been caused to boilers under these circumstances.

CHARLES W. CARTER, JR.,
Dept. of Labor, State of New York.
Binghamton, N. Y.

THE boiler should be emptied and the manholes left open when the boiler is shut down for the summer. Before draining, place several gallons of crude oil in the shell, so that as the water drains out the blowoff, the oil will form a light covering on the shell and tubes.

When ready for service again the oil can be removed with soda ash. All accumulations of soot and ash should be removed and the exterior surfaces coated with boiled linseed oil. Thoroughly clean and dry the ashpit and leave its doors open, as should be the firedoors and damper. Cover the stack with a water-tight hood and make sure that no water can reach the boiler.

RALPH E. HEDGES.

Chicago, Ill.

A Question For Our Readers

UNDER what conditions might the installation of both air preheaters and economizers be justified in a plant using stage bleeding from the main units for feed water heating?

P. A. W.

Suitable answers from readers will be paid for and published in the July 9 issue.

Events and Men in Power's Field

THE EDITORS WILL WELCOME THE CO-OPERATION OF READERS IN REPORTING INTERESTING HAPPENINGS, PERSONAL OR OTHERWISE

N.E.L.A. Meets at Atlantic City

LAST week the National Electric Light Association held its Fifty-Second Convention and Exposition in the new fifteen million dollar municipal auditorium at Atlantic City. The facilities of the auditorium, the large attendance and the theme of the meeting—the honoring of Thomas A. Edison as the inventor of the incandescent lamp fifty years ago—all contributed to make this one of the greatest conventions in the history of the association.

In opening the first general session, President Preston S. Arkwright urged greater co-operation toward the solution of common problems than there has been in the past, to the end that the United States may continue to lead the world in the production and use of electrical energy. He pointed out that this nation produces and uses as much electrical energy as all other nations in the world put together, that the rate of extension of electrification in this country is continuously accelerating, and that the potential market ahead is many times greater than that already developed.

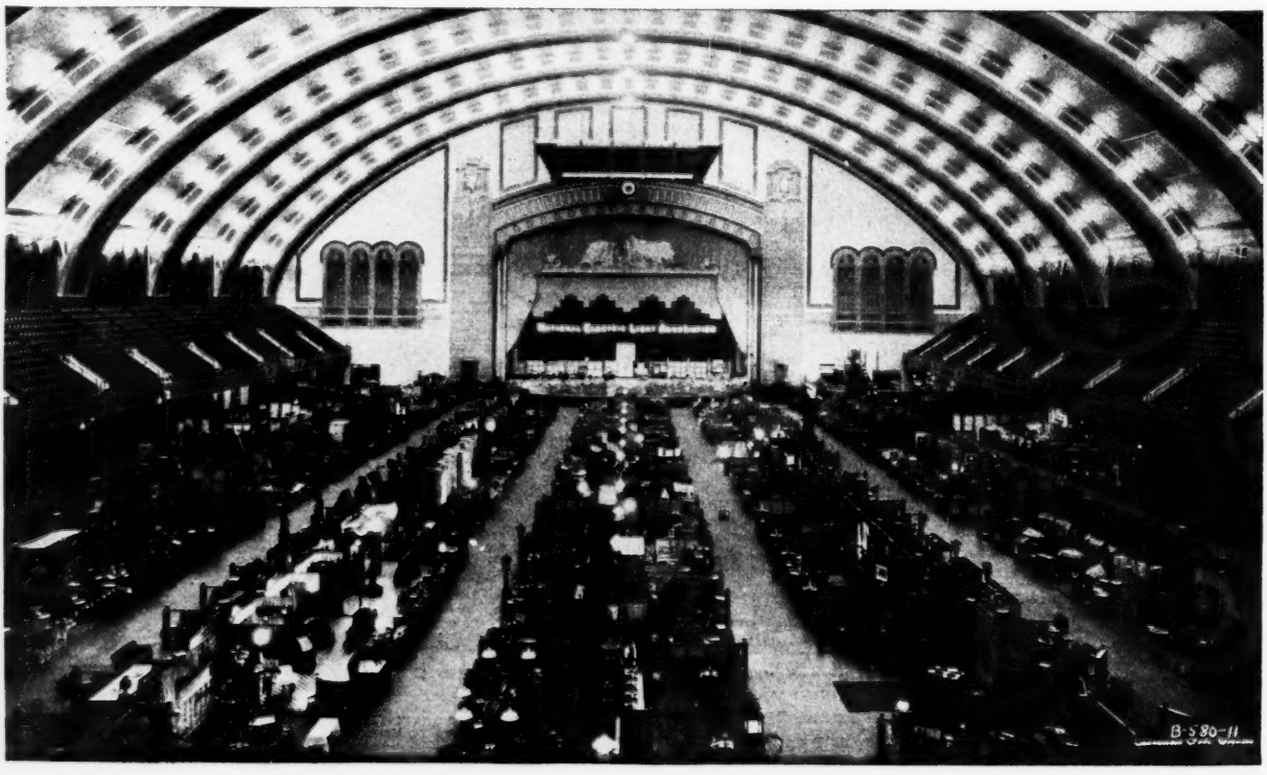
Mr. Arkwright urged tolerance, but firmness of purpose, is dealing with critics; careful introspection as to motives and methods of development, and then aggressive progression along lines determined to be right and for the best interests of the public and the investors in the industry, and concentration of effort of the best minds of the industry in solving some of the present problems confronting the industry.

Addressing the second general session, M. S. Sloan, president of the New York Edison Company, pointed out that trends in the industry over a period of several years show that it is slowly being squeezed between the decline in the kilowatt-hour sales and revenue for each dollar of investment, on the one hand, and a rising investment cost per kilowatt of installed generating capacity, on the other. He presented statistics to show that the number of kilowatt-hours sold for each dollar of investment steadily declined between 1922 and 1927; that the average price per kilowatt-hour sold declined during the same period; that the revenue per dollar of investment has decreased; that the rate of capital turnover has decreased from 4.72 years to 5.58 years, that the installed generating capacity has increased 78 per cent, and that the investment per kilowatt installed has increased from $312 to $367. The average rate of return for the industry in 1922 was 7.58 per cent, whereas in 1926 it was 7.30 per cent, and in 1927 it was 7.48 per cent.

Mr. Sloan interpreted these facts by saying that there has been, in recent years, many rate reductions, particularly in domestic rates and that, at least in part, accounted for the steady decrease in the revenue received for each dollar of investment. Moreover, since the war industry has carried on a tremendous building program.

Answering the question as to whether rates or sales should be increased to meet the problem, Mr. Sloan advocated selling more kilowatt-hours for each dollar of investment, making the equipment work harder and steadier and selling more service in the home.

A. C. Marshall, vice-president and general manager of the Detroit Edison Company, addressed the first engineering session on planning for the future. The two principal factors in this connection are the total investment per dollar of earnings and the operating ratio. He pointed out that there are developments in the industry tending to increase the investment per dollar of earnings, such as the necessity of replacing poles and overhead wires with underground cables, the cost of better and more ornamental substations, the



N.E.L.A. Exhibit at the New Atlantic City Auditorium

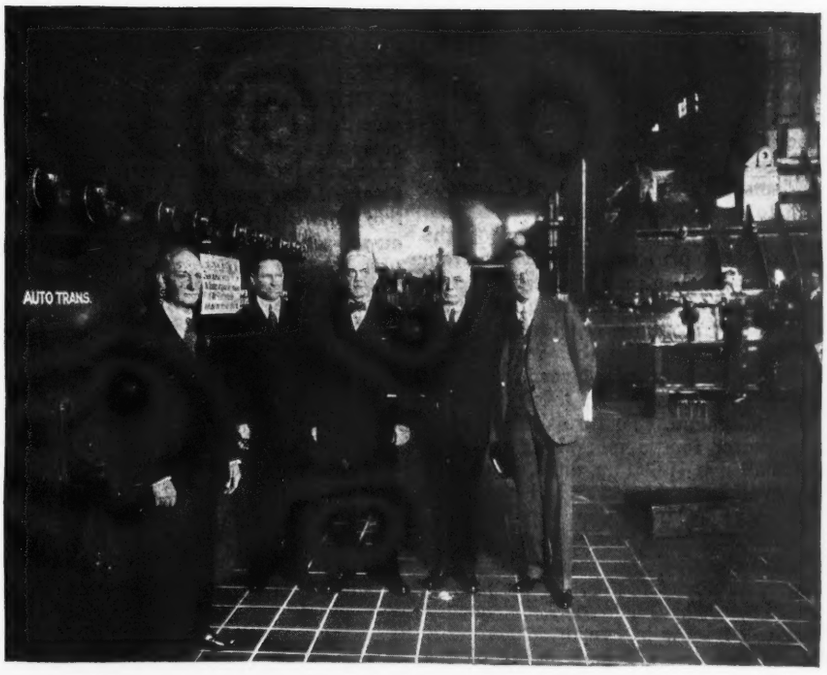
increasing necessity for reliability of service, the trend in industry toward replacing man-power with mechanical power, the large capacity of interconnected systems, and the constant striving for higher steam pressures and temperatures.

The increased sales in residential service usually mean increased earnings without a substantial increase in investment. He was of the opinion that, although the kilowatt-hours will increase as a result of lower rates, this will not offset the increased investment per dollar of earning. The remedy is the reduction of the operating ratio. Operating expenses now range between fifty and sixty cents per dollar return for most power companies, and the investment cost ranges between four and five dollars per dollar earned.

Inability to foresee the tremendous growth of the industry, in the opinion of Mr. Marshall, has been responsible for the retiring of much equipment and the gradual increased investment cost. In order to meet this situation, he urged a master plan for future growth as absolutely necessary, in connection with which budget control will be found of considerable help.

F. R. Phillips, vice-president and general manager of the Philadelphia Company, spoke on "Engineers and Engineers." The type of engineer for which there will always be a crying need must be more than a technician and must be able to design and construct; he must be a manager, well versed in economics, finance and public affairs, possessing a sympathetic understanding and a leader, dominated by a desire to promote the public welfare.

E. C. Stone, chairman of the Engineering Section, emphasized the fact that the electrical light and power companies in the United States have made such progress in fuel efficiency during the last few years that the problems involved in system investment now offer the greatest field for further major economies.



OFFICIALS who participated in the dedication of two new turbine-generators, each of 160,000 kw. capacity, at the Hell Gate Generating Station of the United Electric Light & Power Company, May 29. President Matthew S. Sloan of The New York Edison Company and associated companies, operates a switch that controls the generator ventilating blowers of the Westinghouse unit in the background. The other turbine-generator is an American Brown Boveri unit. The officials, left to right, are: Frank W. Smith, vice-president and general manager, United Company; President Sloan; William A. Prendergast, chairman of the Public Service Commission; George B. Cortelyou, president of the Consolidated Gas Company, and John W. Lieb, senior vice-president, New York Edison Company.

A.S.T.M. Annual Meeting to Be Held June 24-28

The American Society for Testing Materials will hold its 32nd annual meeting at Chalfonte-Haddon Hall, Atlantic City, N. J., on June 24-28. A wide variety of subjects will be presented at the fifteen technical sessions, including a symposium on the properties of cast iron, the standardization of dimensions and material of wrought-iron and wrought-steel pipe and tubing, a study of refractories, and a report on boiler feed-water research.

One session will be devoted entirely to the Edgar Marburg Lecture and presentation of the Charles B. Dudley medal. Dr. Saul Dushman, assistant director of the General Electric Company research laboratory, will deliver the Marburg lecture this year, and his topic will be "The Nature of Cohesive Forces in Solids." The third award of the Charles B. Dudley medal, established by the A.S.T.M. for recognition of meritorious papers on research in engineering materials, will be made to J. J. Kanter and L. W. Spring, joint authors of "Long-Time or Flow-Tests of Carbon Steels at Various Temperatures with Particular Reference to Stresses Below the Proportional Limit," presented at the annual meeting of the Society in 1928.

Social features of the meeting include an informal dance and smoker to be held on Wednesday evening following the session devoted to the Dudley medal award, and the annual golf and tennis tournaments to be held on Friday at the close of the meeting.

Economical Operation Stressed at Power Group Meeting

The difference between efficient and economical operation of generating stations was emphasized in two papers presented at a meeting of the Power Group of the New York Section of the American Institute of Electrical Engineers held in New York City on May 28.

The first paper entitled "The Economical Division of Generating Means," was given by J. D. Winans and F. W. Gay, of the Public Service Production Company, Newark, N. J., and brought out the fact that where the installation of a base-load station on a public utility system cannot materially increase the average efficiency of generation, consideration should be given to the use of artificial water power (pump storage) and gasoline engine units for peak-load installations.

In the other paper, "Experience with the Rocky River Hydro-Electric Development," E. J. Amberg, research engineer with the Connecticut Light & Power Company, described the only large pumped-storage reservoir operating in America. The Rocky River station is used as a peak-load installation to supplement the Devon steam plant of the company and has worked out very satisfactorily.

George Sutherland, assistant general superintendent of the New York & Queens Light & Power Company, was elected chairman of the Power Group for 1929-30 at the meeting, and a motion picture on the development of the Conowingo hydro project was shown.

Tidal Power Project for Passamaquoddy Bay

Dexter L. Cooper, Inc., has applied to the Federal Power Commission for a license covering a proposed tidal power development at Passamaquoddy Bay. The plan calls for the immediate installation of 464,000 hp. and the ultimate installation of 1,087,000 hp. The project contemplates the construction of a series of dams connecting the main

land with islands across the mouth of Passamaquoddy Bay to impound tidal waters within that bay. Another series of dams is to be constructed between Passamaquoddy Bay and Cobscook Bay. The power house is to be erected at that point. In addition there will be a series of dams across the mouth of Cobscook Bay to exclude tidal waters.

A recently adopted feature of the project is a plan to pump water from Haycock Harbor into a reservoir to be constructed on the mainland at an elevation of 140 ft. above sea level. Water will be pumped into this reservoir at such times that excess power is available and drawn down when tidal power is at its minimum. To furnish the necessary power for pumping it is proposed to install five 41,000-hp. units. By making available this power it is expected that many steam plants in Maine, in northeastern Massachusetts and in New Brunswick can be eliminated. Mr. Cooper estimates the cost of the project at $93,000,000. The War Department's district engineer has reported favorably on the project, although he is of the opinion that the project will cost $100,000,000 and that it will require seven years to construct. Mr. Cooper estimates that the construction can be done in three years.

Committee on Economic Changes in New York to Meet

The special committee, appointed by the New York State-Wide Economic Congress at a three-day meeting held in New York City last month, will be called together in a short time to propose a course of action in the interest of the state and secure public approval of it. Problems bearing on industrial and economic conditions in the State of New York will be considered and recommendations will be made along lines laid down by the survey of economic changes presented at the meeting of the Congress.

This Congress represents a general economic movement in New York State similar to others that are being fostered nationally and in some branches of industry. Its officers are: Chairman, Merwin K. Hart, Hart & Crouse, Utica; vice-chairmen, James W. Gerard and Elmer E. Brown; treasurer, Michael H. Cahill; and executive secretary, Col. Arthur F. Crosby.

The committee comprises in its membership the leading representatives of business and industry in New York State, among whom are: Charles E. Adams, president, Air Reduction Company; Magnus W. Alexander, president, National Industrial Conference Board; Elmer E. Brown, chancellor, New York University; Frederick C. Ferry, president, Hamilton College; James W. Gerard, former ambassador to Germany; James H. McGraw, chairman, McGraw-Hill Publishing Company; Charles S. Ruffner, president, Mohawk Hudson Power Company; and Edward Miner, president, Pfaudler Company.

Spot * News

THE CHARLES A. COFFIN *prize, awarded annually to that central station company which has done most for the advancement of the electrical art, was awarded this year to the El Paso Electric Company of El Paso, Texas. The award was made at the annual convention of the National Electric Light Association, at Atlantic City on June 6.*

* * *

IN RECOGNITION *of the outstanding services of H. M. Atkinson, chairman, Georgia Power Company, in the development of the power industry in the South, the new 100,000-hp. steam generating plant to be constructed by the company near Atlanta will be named the Atkinson Steam Plant. Preliminary work has been started on the first unit of the station which, when completed, will be one of the largest in the South.*

* * *

A STEAM-DRIVEN, *six-wheel motor bus, seating 40 passengers, has been built recently with an eight-cylinder steam engine to drive it through worm gears directly connected to the rear axle. A small auxiliary steam engine provides power for the operation of the electric generator to run the condenser, fans and air compressor and furnish lights. Fuel oil is used to generate steam.*

* * *

TEN HYDRO-ELECTRIC *power plants that develop more than 450,000 kw., operating as a chain and utilizing the waters of the Lewis River, Wash., in ten successive operations, is the contemplated development of the Northwestern Electric Company, of Portland, Ore.*

* * *

ONE OF THE LARGEST *leather belts ever made has just been completed to transmit loads from 1,200 to 1,500 hp. at a speed of approximately 4,700 ft. per minute. It measures 74 in. wide, 3-ply and more than 100 ft. long. The manufacturers, Chas. A. Schieren Company, used 234 backbone centers from steer hides in the construction of the belt.*

* * *

CONSTRUCTION WORK *has been started by the Utah Power & Light Company on an addition to its Jordan steam-electric generating station in Salt Lake City. The installation of two boilers with a heating surface of 18,000 sq.ft. each will increase the capacity of the plant to 41,000 kilowatts.*

* * *

AN EDISON FELLOWSHIP *for research in the General Electric research laboratory at Schenectady, N. Y., has been established in honor of Thomas A. Edison and in commemoration of the 50th anniversary of his lamp.*

Simplified Practice Adopted by Coal Dock Operators

Simplification of the sizes and terminology of high-volatile bituminous coal was unanimously agreed to by dock operators, wholesale and retail dealers, and users at a recent conference held under the auspices of the Division of Simplified Practice of the Department of Commerce at St. Paul, Minn. Though this recommendation applies only to high-volatile bituminous coal handled over the docks at the American head of the Great Lakes and distributed mainly in the states of Minnesota, North Dakota, South Dakota, Montana, Iowa, Wisconsin and Michigan, it has attracted the interest of coal dealers and users throughout the country.

Effective May 1, the recommendation specifies the following sizes and terminology shall be standard practice:

1. Block—Coal passing over a 4-in. screen.
2. Lump—Coal passing over a 2-in. screen.
3. Egg—Coal passing through a 4 in. screen, and over a 2-in. screen.
4. Stove—Coal passing through a 2-in. screen and over a 1¼-in. screen.
5. Nut and Slack—Coal passing through a 2-in. screen.
6. Screenings—Coal passing through 1¼-in. screen.

The above stated screen sizes refer to round hole or square mesh screens.

Work on Seven Sisters Project Progresses Rapidly

Work is progressing rapidly on the big power project of the Winnipeg Electric Company at Seven Sisters Falls, on the Winnipeg River, in the province of Manitoba. Already the initial cofferdam across the stream is nearing completion. The full capacity of the site is 225,000 hp. in six units of 37,500 hp. each. The initial development will be three units which, it is planned, will deliver power to Winnipeg early in 1931. On completion, Seven Sisters will be the largest power plant in Manitoba, producing more power than the existing two subsidiaries of the Winnipeg Electric Company at Pinawa Falls and Great Falls, whose combined capacity is 203,000 hp.

The new Seven Sisters plant will be the last word in modern electrical engineering and one of the most up-to-date installations on the American continent. When it is completed, the present Pinawa plant, delivering 35,000 hp., will be dismantled.

Diesel Drives to Solve Problems of River Navigation

In order to meet the peculiar requirements imposed by navigating conditions on the upper Mississippi, engineers of the Inland Waterways Corporation have prepared plans for a Diesel-driven, compressed-air towboat which it is believed will give a maximum amount of power per unit of weight. The boat is to be of 1,000 hp. and will operate on a four-foot draft.

In addition to the saving in weight that can be accomplished by this type of power unit, it is claimed that the fuel cost will be much less than for the steam-driven towboats.

It is also claimed that the Diesel engine has an advantage over the steam power unit used on the other towboats, in that it can be started and stopped immediately. Marine engineers do not believe that it is practicable to transmit the power directly from a Diesel engine to a stern wheel, such as is used on the river towboats. This is because it is pointed out that the revolutions of a stern wheel are much slower than those of a screw propeller and it is not believed that a Diesel engine can be geared down so low with any degree of efficiency. The application of power to the stern wheel by means of a compressed air driven engine, is thought to be a solution to the problem. It is stated that the Nordberg Company, of Milwaukee, is prepared to produce the Diesel-driven compressed-air engine and has indicated a willingness to guarantee its operation.

Canadian Electrical Association Annual Convention

The 39th annual convention of the Canadian Electrical Association will be held at the Algonquin Hotel, St. Andrews-by-the-Sea, New Brunswick, June 19-21. A feature of the meeting will be the reports of the engineering section on electrical apparatus, hydraulic power, inductive co-ordination, transmission and power systems engineering. Addresses by W. A. Jones, vice-president of Henry L. Doherty Company, and C. E. Greenwood, commercial director of the National Electric Light Association, will be heard, and two important papers will be given, one on "Recent Research Developments," by C. E. Skinner, research engineer, Westinghouse Electric & Manufacturing Company, and the other "Electricity in Industry," by R. H. Rogers, Industrial Engineering Department, General Electric Company. The entertainment program will include dancing, outdoor sports and a trip around Passamaquoddy Bay.

International Coal Conference Proceedings Published

A record of the latest scientific developments in the improved utilization of bituminous coal as a raw material is now available in the published proceedings of the Second International Conference on Bituminous Coal held at the Carnegie Institute of Technology in November, 1928.

The Proceedings are published in two volumes containing a total of 1,927 pages of type matter and illustrations. The text is composed of 111 different manuscripts by some of the world's foremost fuel technologists, chemists and engineers, complete discussions by delegates, and a 40-page index. A majority of the proceedings are accompanied by illustrations, charts and tables.

That the Carnegie Institute of Technology is already making preliminary plans for a third international coal conference is indicated in the foreword by Dr. Thomas S. Baker, president of the Carnegie Institute of Technology and organizer of the first and second conferences. "The success of the Carnegie Congresses and the developments in fuel technology which may be expected in the future," according to his foreword, "encourage us to believe that another International Conference would be welcomed and would be of value." The Carnegie authorities, however, have not yet fixed a date for the third conference.

The second conference, according to the published proceedings, had a registration of about two thousand including delegates from 22 countries. The papers reproduced in the proceedings cover low-temperature distillation, origin, composition and classification of coal, use of pulverized fuel, fertilizers from coal, purification and cleaning of coal, power and combustion, liquefaction of coal, tar and oil from coal, gasification of coal, and high-temperature distillation.

Men in the News

GEORGE A. BURNHAM

president of the Condit Electrical Manufacturing Company, has been elected president of American Brown Boveri Company, Inc., Camden, N. J., a newly formed subsidiary of the American Brown Boveri Electric Corporation, created for the purpose of placing all electrical and mechanical operations, exclusive of shipbuilding, under one management. Mr. Burnham is a native of Massachusetts, and prior to his connection with the Condit company he was engaged in the construction and operation of power plants.

Other officers of the new company are: Maurice L. Sindeband, vice-president; Joseph T. Graham, secretary and treasurer, and William S. Edsall, general sales manager.

OBITUARY

H. S. BRADLEY, president of the Lagonda Manufacturing Company, which he had headed for 31 years, died at the age of 76 at his home in Springfield, Ohio, May 15, 1929. He had been in poor health for the last few years.

After serving as secretary of the Foos Manufacturing Company for 16 years, he started the Lagonda Manufacturing Company in a very small way in 1898. At that time the water-tube boiler was coming into prominence, bringing with it the problem of cleaning the boiler tubes. Mr. Bradley saw the need, and the tube cleaner he built became popular with engineers. The business grew very rapidly, and for many years the Lagonda tube cleaner has been standard boiler room equipment.

PERSONALS

JOHN R. FREEMAN, consulting hydraulic engineer, of Providence, R. I., an internationally recognized authority on hydraulic engineering matters, has been awarded the title of Honorary Fellow of the Polytechnic Institute of Karlsruhe, Germany.

R. L. DAUGHERTY, a vice-president of the A.S.M.E., recently became the chief executive of the city of Pasadena, Calif. succeeding Clayton R. Taylor, as chairman of the Board of City Directors.

L. J. BELNAP, president of the Worthington Pump & Machinery Company, has returned from a six weeks' study of European conditions. He visited London, Paris, Berlin, Ghent, Madrid, Milan, Vienna and Budapest.

J. C. KRUM, of Toronto, Ont., formerly on the staff of the Ontario Hydro-Electric Power Commission, has been appointed chief designer for the Northwestern Power Company in connection with Seven Sisters Falls power development in Manitoba.

G. S. BROWN has left Concord, N. C., for Tallahassee, Fla., to take charge of the completion of a large power development being engineered by Mees & Mees, of Charlotte, N. C. The total cost of the project is more than $4,000,000.

B. A. PARKS, chairman of the Peninsula Section of the A.S.M.E., was elected recently a member of the City Commission of Grand Rapids, Mich. The group supporting Mr. Parks ran him under the slogan, "You Put an Engineer in the White House, Why Not One on the Commission?"

J. R. MCDERMET has been appointed chief engineer of the Elliott Company. As research engineer with that company

for the last twelve years, he further developed the original deaërator and contributed pioneer thoughts on the subject of deaëration of boiler feed water.

W. P. THOMAS, formerly secretary of the Diamond Power Specialty Corporation, has been elected vice-president of that organization.

BUSINESS NOTES

THE AMERICAN DISTRICT STEAM COMPANY, North Tonawanda, N. Y., at its annual meeting elected the following officers: Robert Hall, president and treasurer; N. D. Fish, vice-president; G. H. West, secretary; and H. C. Jagow, assistant treasurer.

THE PENNSYLVANIA PUMP & COMPRESSOR COMPANY, Easton, Pa., has appointed Wells Fargo & Company, Express, S.A. Apartado Postal 361, as its agents for the Republic of Mexico.

THE WAGNER ELECTRIC CORPORATION, of St. Louis, announces the appointment of L. G. Tandberg as branch manager of its Los Angeles sales office at 1220 S. Hope Street.

THE GARFIELD FIRE CLAY COMPANY, Robinson, Pa., has moved its Eastern sales office to 1010 Harrison Building, Philadelphia, where H. I. Robinson and D. J. Matheson will be in charge.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY'S Pittsburgh offices are now in the Grant Building, it has been announced by J. Andrews, Jr., central district manager of the company.

THE CHICAGO PUMP COMPANY announces the addition to its sales representation of P. S. Lord, with offices at 406 Weatherly Building, Portland, Ore.

THE MINNEAPOLIS-HONEYWELL REGULATOR COMPANY has embarked on an expansion program involving an expenditure of $300,000, which will include the construction of a new wing six stories high and adding 50,000 sq.ft. to the present plant.

THE BROWN INSTRUMENT COMPANY, of Philadelphia, has moved its Boston office to 1107 Public Service Building, 89 Broad St., to care for rapid growth of the company's business in the New England territory.

JOHNS-MANVILLE CORPORATION, of New York, announces the removal of the Milwaukee sales office to the Railway Exchange Building, 97 East Wisconsin Ave.

THE NORTH AMERICAN REFRACTORIES COMPANY, with general offices in Cleveland, Ohio, has been formed through the consolidation of the following companies: Ashland Fire Brick Company, Ashland, Ky.; Crescent Refractories Company, Curwensville, Pa.; Dover Fire Brick Company, Cleveland, Ohio; Elk Fire Brick Company, St. Marys, Pa.; Farber Fire Brick Company, Farber, Mo., and Queens Run Refractories Company, Lock Haven, Pa.

Coming Conventions

American Institute of Electrical Engineers, annual summer convention, Swampscott, Mass., June 24-28. Pacific Coast Regional Meeting, Santa Monica, Calif. Sept. 3-6. F. L. Hutchinson, secretary, 33 West 39th St., New York City.

American Society of Heating and Ventilating Engineers, annual summer meeting, Bigwin Inn, Lake of Bays, Ontario, Can., June 26-28. A. V. Hutchinson, secretary, 29 W. 39th St., New York City.

American Society of Mechanical Engineers, spring meeting, Salt Lake City, Utah, July 1-4, 1929. Calvin Rice, secretary, 29 West 39th St., New York City.

American Society of Refrigerating Engineers. Summer convention at Penn State College, State College, Pa., June 20-22. Secretary, W. H. Ross, 35 Warren St., New York City.

American Society for Testing Materials. Annual meeting, June 24-28, at Chalfonte-Haddon Hall, Atlantic City, N. J. Secretary, C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

American Welding Society. Fall meeting at Cleveland, Ohio, Sept. 9-13. Secretary, M. M. Kelly, 33 West 39th St., New York City.

Association of Iron and Steel Electrical Engineers, 25th annual convention, Pittsburgh, Pa., June 17-22, 1929. A. A. Stewart, secretary, Pittsburgh Steel Co., Monnessen, Pa.

Canadian Electrical Association, annual convention, to be held June 19-21, at St. Andrews-by-the-Sea, N. B. H. M. Lyster, secretary, Power Building, Montreal, Que.

National Association of Power Engineers, 47th annual convention, Chattanooga, Tenn., Sept. 9-13. Fred Raven, secretary, 417 South Dearborn St., Chicago, Ill. Conn. State Association annual meeting, June 14-15, at the Stratfield Hotel, Bridgeport, Conn. New England States Association annual meeting, June 20-21, at Fitchburg, Mass.

National Association of Practical Refrigerating Engineers. Twentieth annual convention at the William Penn Hotel, Pittsburgh, Pa., Nov. 4-7. Secretary, E. H. Fox, 5707 W. Lake St., Chicago, Ill.

National Board of Boiler and Pressure Vessel Inspectors. Annual meeting, June 18-20, at Detroit, Mich. Secretary, C. O. Myers, 14 Commercial Nat'l Bank Bldg., Columbus, Ohio.

National Exposition of Power and Mechanical Engineering, Grand Central Palace, New York City, Dec. 2-7. Charles F. Roth, manager, Grand Central Palace, New York City.

National District Heating Association. Annual meeting, June 11-14, at the Hotel Statler, Detroit, Mich. Secretary, D. L. Gaskill, Greenville, Ohio.

National Oil and Gas Power Meeting. Under auspices of A.S.M.E. Oil and Gas Power Division and the Pennsylvania State College. June 24-27, State College, Pa. F. G. Hechler, chairman, State College, Pa.

Northwest Electric Light and Power Association. 22nd Annual Convention, June 26-29, 1929, at Seattle, Wash. Registration and information: J. J. Hayes, Westinghouse Electric & Manufacturing Company, Seattle, Wash.

Universal Craftsmen Council of Engineers. Annual meeting in Detroit, Mich., Aug. 6-10, at the Book-Cadillac Hotel. Grand Secretary, T. H. Jones, 33 Linden Ave., Cherrydale, Va.

World Engineering Conference, Tokyo, Japan, October, 1929. All correspondence should be addressed to the Secretary, World Engineering Conference, Nikon, Kogyo Club, Morunouchi, Tokyo.

THE CHICAGO STEEL & WIRE COMPANY and its associate, Fusion Welding Corporation, both of Chicago, announce plans for the construction of new general offices adding over 8,000 sq.ft. to the space they now occupy. The latter company recently appointed F. O. Weber, 229 Boulevard Des Allies, Pittsburgh, Pa., as sales manager for the Pittsburgh district.

THE UNION IRON WORKS, of Erie, Pa., announces the following changes: The Chicago office in charge of C. B. Adams has moved to the 333 North Michigan Avenue Building, and Joseph Lappin, New York representative, has moved to 1819 Broadway, New York City.

FUEL PRICES

COAL

The following table shows the trend of the spot steam market in various coals, f.o.b. mines; mine run, except Pittsburgh gas slack:

Bituminous (Net Tons)	Market Quoting	Price per Ton
Navy Standard	New York	$2.35 @$2.40
Kanawha	Columbus	1.25 @ 1.45
Smokeless	Cincinnati	1.75 @ 2.00
Smokeless	Chicago	1.75 @ 2.25
S. E. Kentucky	Chicago	1.35 @ 1.60
Steam	Pittsburgh	1.55 @ 1.65
Gas Slack	Pittsburgh	1.00 @ 1.15
Big Seam	Birmingham	1.25 @ 1.50
Anthracite (Gross Tons)		
Buckwheat	New York	$2.75
Barley	New York	1.50

FUEL OIL

New York—June 6, f.o.b. Bayonne, N. J., 28@34 deg., Baumé, industrial use, tank-car lots, 4.75c. per gal.; 36@40 deg., furnace, tank-car lots, 6c. per gal.

St. Louis—May 29, tank-car lots, f.o.b. St. Louis, 24@26 deg., $1.3708 per bbl. or 42 gal.; 26@28 deg., $1.4208 per bbl.; 28@30 deg., $1.4708 per bbl.; 30@32 deg., $1.5208 per bbl.; 32@36 deg., gas oil, 4.151c. per gal.; 38@40 deg., distillate, 5.23c.

Pittsburgh—May 20, f.o.b. local refinery, 30@34 deg., fuel oil, 5c. per gal.; 36@40 deg., 5.5c. per gal.

Philadelphia—June 5, 13@19 deg., $1.05@$1.10 per bbl. or 42 gal.; 22 deg. plus, $1.575@$1.625 per bbl.; 23@27 deg., $2.10@$2.15 per bbl.

Cincinnati—May 27, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 5c. per gal.; 26@30 deg., 5.25c. per gal.; 30@32 deg., 5.5c. per gal.

Chicago—June 1, tank-car lots, f.o.b. Oklahoma, freight to Chicago, 90c. per bbl. or 42 gal.; 22@26 deg., 60c. per bbl.; 26@30 deg., 72.5c. per bbl.; 30@32 deg., 95c. per bbl.

Boston—May 27, tank-car lots, f.o.b. 12@14 deg. Baumé, 4.35c. per gal.; 28@32 deg., 5.5c. per gal.

Dallas—June 1 f.o.b. local refinery, 26@30 deg., $1.30 per bbl. or 42 gallons.

Trade Catalogs

Centrifugal Pump—A new high-pressure, multi-stage, centrifugal pump is illustrated and described in a recent folder published by Goulds Pumps, Inc., Seneca Falls, N. Y.

Power Control Valve — Consolidated Ashcroft Hancock Company, 100 East 42nd St., New York City, presents the Ashcroft power control valve in an 8-page illustrated bulletin, No. 1525, which covers the function, capacity, advantages of installation and details of operation of the valve.

Pyrometers—Supplement No. 1 to Bulletin No. 400 has been issued by the Roller-Smith Company, 233 Broadway, New York City, giving a description and list of applications of Type FD pyrometers.

Water Columns and Gages—A 24-page illustrated catalog, WG-1802, describing Floatless Hi-Lo Alarm Water Columns and Se-Sure Inclined Water Gages has been issued by the Yarnall-Waring Company, Chestnut Hill, Philadelphia, Pa. Gray iron and forged steel water columns for all working pressures up to 1,400 lb. are shown, together with inclined and vertical gages with round or flat glasses.

Air-Jacketed Motors—Bulletin 151, 3rd Revision, issued by the Wagner Electric Corporation, 6400 Plymouth Ave., St. Louis, Mo., contains a discussion of dust, fume and moisture problems requiring special protection for motor and property.

Oiling Systems—Bulletin 16, issued by Wm. W. Nugent & Company, 410 N. Hermitage Ave., Chicago, Ill., illustrates and describes sight feed valves, sight-feed oilers, capillary oilers, sight flows, alarms, oil cups, etc. The booklet, which contains 16 pages, is entirely new.

Protective Coatings — Bulletin 1170, recently published by the Dampney Company of America, Boston, Mass., illustrates and describes various types of power-plant equipment to which Apexior coatings are applied to prevent corrosion. Equipment for applying the coatings to the internal surfaces of bent and straight boiler tubes is also shown.

V-Notch Meters — The Cochrane Corporation, 17th St. & Allegheny Ave., Philadelphia, Pa., has prepared a 20-page bulletin, No. 679-A, which gives a complete description of the construction and operation of V-notch meters. Many illustrations of installations are included in the booklet.

Gas Engines—Full details of construction and operation of vertical gas engines are given in illustrated Bulletin 782, recently issued by the Chicago Pneumatic Tool Company, 6 East 44th St., New York City.

Turbines—Leaflet 20401 describes Type AD mechanical drive turbines in capacities from 5 to 50 hp. at 650 to 4,000 r.p.m.; and leaflet 20408 covers non-reversing magnetic starters for wound rotor induction motors. Both are issued by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

New Plant Construction

COMPILED BY THE MCGRAW-HILL BUSINESS NEWS DEPARTMENT, WHICH IS PREPARED TO FURNISH A MORE COMPLETE DAILY SERVICE TO THOSE WHO WISH IT

Ariz., Lowell—Calumet & Arizona Mining Co., is having plans prepared for the construction of a steam-operated electric power plant near here. Estimated cost $300,000.

Ariz., Phoenix—Central Arizona Light & Power Co. and Salt River Valley Water Users Association, plan the construction of an 18,000 kw. electric power plant with steam generation near here.

Ark., Hot Springs—J. A. Rector, 208 North Broadway, St. Louis, Mo. and B. N. Jackson, New Orleans, La., awarded contract for a 14 story medical arts building on Central Ave. here to G. Walker, Little Rock, Ark. Estimated cost $1,000,000.

Calif., Los Angeles — Banks-Huntley Co. is having plans prepared for a 13 story office building including steam heating system, elevators, etc. at Spring St. between 6th and 7th Sts. Estimated cost $1,000,000. J. & D. B. Parkinson, 808 Title Insurance Bldg., are architects.

Calif., Los Angeles—Central Funding Co. of Hollywood, is having plans prepared for a 12 story hotel including steam heating system, elevators, etc. on Vine St. Estimated cost $1,000,000. L. L. Jones, 2504 West 17th St., is architect.

Calif., Los Angeles—J. W. Clune, 117 West 9th St., awarded contract for a 13 story office building at 9th St. and Broadway to J. V. McNeil Co., 5860 Avalon Blvd. Estimated cost $1,000,000.

Calif., Los Angeles—Eastern Outfitting Co., 620 South Main St., is having preliminary plans prepared for a 13 story, stores and loft building at 9th St. and Broadway. Estimated cost $1,000,000. C. Beelman, Union Bank Bldg., is architect.

Calif., Los Angeles—J. Kalb, 416 West 8th St., is receiving bids for a 7 story apartment building including steam heating system, elevators, etc. at 458 South Catalina St. Estimated cost $500,000. S. C. Lee, 531 Petroleum Securities Bldg., is architect.

Ga., Rokkmart—City, L. C. Hulsey, Supt. of Water & Light Dpt., City Hall, plans the construction of a waterworks system including filtration plant, pumping station, etc. Estimated cost $65,000. Work will be done by owner's forces.

Idaho, Lewiston—Idaho Power Co., 7th and Bannock Sts., Boise, is having preliminary plans prepared for the construction of a hydro-electric power plant on Snake River near here.

Ill., Chicago—J. H. Cundy & Associates, 6759 Cornell Ave., are having plans prepared for a 13 story apartment building at Blackstone Ave. and 52nd St. Estimated cost $2,000,000. P. F. Olsen, 720 Cass St., is architect.

Ill., North Chicago—American Can Co., 129 Broadway, New York, N. Y., will build a printing plant, boiler house, etc. here. Work will be done by day labor. Estimated cost $200,000.

Ill., Springfield—City, c/o J. E. Smith, Mayor, will receive bids until June 10 for the construction of an automatic electric sub-station. Burns & McDonnell Engineering Co., Interstate Bldg., Kansas City, Mo., is engineer.

Ill., Springfield—State appropriated $150,000 for extensions and alterations to power house, also plans to construct tunnel from State Capitol to power house. H. A. Hammond, Capitol Bldg., is associate architect.

Ind., Indianapolis—American Central Life Insurance Co., H. M. Woolen, Pres., 8 East Market St., is having plans prepared for the construction of an office building at Meridian St. and Fall Creek Blvd. Estimated cost $1,000,000. Rubush & Hunter, American Central Life Bldg., are architects.

Ia., Cedar Falls—State Teachers College, is having plans prepared for the construction of a heating plant. Estimated cost $350,000. Proudfoot, Rawson & Souers, 810 Hubbell Bldg., are architects.

Ia., Harlan—City, c/o J. W. Bailey, Clk., awarded contract for complete change of electric light system from direct to alternating system to Electric Equipment Co., 213 Grand St., Des Moines.

Ia., Sioux City—Fourth and Jackson Building Co., will soon award contract for a 12 story office building at Fourth and Jackson Sts. Estimated cost $750,000. K. E. Westerlind, 116 War Eagle Bldg., is architect.

Kan., Topeka—Mutual Ice & Cold Storage Co., 112 East First St., awarded contract for the construction of a cold storage and refrigeration plant to F. M. Spencer & Co., 1805 Harrison St. Estimated cost $50,000.

Kan., Wichita—Ritz Hotel Co., Union National Bank Bldg., awarded contract for a 16 story hotel at First and Topeka Sts. to Manhattan Construction Co., Court Arcade Bldg., Tulsa, Okla. Estimated cost $1,750,000.

Ky., Louisville—U. S. Engineers Office, P. O. Box 72, will receive bids until June 27 for remodeling power house at Lock 41.

Md., Crownsville—Bd. of Trustees, Crownsville State Hospital, plans the construction of a central steam power plant. Estimated cost $75,000. James Posey, 201 West Franklin St., Baltimore, is mechanical engineer.

Mass., Boston—Homeopathic Hospital, G. B. Gliden, Chn. Bldg., Comm., 551 Tremont St., is having plans prepared for an 8 or 10 story hospital and medical school at Commonwealth Ave. and Grandy St. Estimated cost $1,000,000. Kendall, Taylor & Co., 142 Berkley St., are architects.

Mass., Boston—G. D. Zahm Corp., 551 5th Ave., New York, N. Y., will soon award contract for a 16 story hotel building at Causeway and Nashua St. here. Estimated cost $2,000,000. Funk & Wilcox, 26 Pemberton Sq., Boston and G. B. Post & Sons, 101 Park St., New York, N. Y., are architects.

Mich., Jackson — Union National Bank, awarded contract for a 15 story bank and office building on Michigan Ave. to O. Misch Co., 159 East Columbia St. Estimated cost $1,000,000. Steam heating and ventilation systems, boilers, elevators, etc. will be installed.

Mich., Royal Oak—Grant S. Oliver Co., 300 East Fourth St., is having plans prepared for the construction of a 4 story hotel and theatre building including steam heating system, boiler, elevators, etc. at Washington and Fourth Sts. Estimated cost $500,000. R. J. MacDonald, 429 Wayne St., Detroit, is architect.

Minn., Minneapolis—S. S. Kresge Co., Kresge Bldg., Detroit, Mich., will soon award contract for the construction of a 4 story department store including steam heating system, elevators, etc. on Nicollet Ave. and 7th St. here. Estimated cost $600,000. Private plans.

Miss., Meridian—Threefoot Realty Co., c/o L. Threefoot, Lamar Hotel, will receive bids until June 24 for a 15 story office building at 6th St. and 22nd Ave. Estimated cost $650,000. C. H. Lindsley, Lamar Life Bldg., Jackson, and F. Fort Meridian, are associate architects.

Mo., St. Louis—Washington University School of Medicine, 602 South Euclid Ave., will receive bids about July 15 for the construction of an 11 story hospital including steam heating system, etc. Estimated cost $2,000,000. Jamieson & Spearl, 1116 Arcade Bldg., are architects.

Neb., Lincoln—University of Nebraska, is having plans prepared for the construction of a steam power plant. Estimated cost, $450,000. Burns & McDonnell Engineering Co., Interstate Bldg., Kansas City, Mo., is consulting engineer.

N. J., Belleville—Bd. of Chosen Freeholders, Hall of Records, Newark, awarded contract for the construction of a hospital, nurses home, etc. to A. C. Windsor, 717 Broadway, Newark. Estimated cost $2,007,000. Steam heating and ventilation systems, etc. will be installed.

N. J., Hackensack—Public Service Electric & Gas Co., 80 Park Pl., Newark, is having preliminary plans prepared for the construction of an electric distribution plant on Newman St. Estimated cost $250,000. Public Service Production Co., 80 Park Pl., Newark, is architect.

N. J., Jersey City—Brunswick Laundry Co. Inc., 222 Tounele Ave., will receive new bids about June 15 for the construction of a power house and boiler room at 68-70-72 Liberty Ave. Estimated cost $160,000. P. Simeone & Co. Inc., 22 Journal Sq., are architects and engineers.

N. J., Perth Amboy—Amboy Ice Mfg. Co., c/o B. Goldberger, 117 Smith St., Archt. is having plans prepared for the construction of an ice plant at Goodwin and Fayette Sts. Estimated cost $50,000.

N. Y., New York—Elgepia Realty Improvement Co., H. Weiss, Secy., c/o Bloomingdale Bros., 59th St. and Lexington Ave., will soon receive bids for the construction of a boiler room, storage building, etc. at 32 West 30th St. Estimated cost $150,000. W. Hohauser Inc., 17 West 44th St., architect.

O., Apple Creek—Dept. of Welfare, H. H. Griswald, Dir., Ninth and Oak Sts., Columbus, is having plans prepared for a group of buildings including power plant, etc. here for Institution of Feeble Minded. Estimated cost $700,000.

O., Akron—Medical Arts Building Co., F. A. Seiberling, Pres., 41 East Mill St., will soon award contract for the construction of an 8 story medical arts building. Estimated cost $1,000,000. Good & Wagner, 191 South Main St., are architects.

O., Cleveland—Cleveland Electric Illuminating Co., Public Sq., had plans prepared for the construction of an electric sub-station at East 79th St. and Union Ave. Estimated cost $125,000. Private plans.

O., Cleveland—Cleveland Union Terminal Co., C. L. Bradley, Pres., Terminal Tower, awarded contract for an 18 story bank and office building at West 2nd St. and Prospect Ave. to Aronberg-Fried Inc., Terminal Tower. Estimated cost $5,000,000. Steam heating and ventilation systems, elevators, etc. will be installed.

O., Cleveland—Shaker Co., c/o J. J. Arnold, Pres., Terminal Tower, will soon award contract for the construction of a central heating plant at East 132nd St. and Shaker Blvd. Estimated cost $200,000. P. L. Small & Associates, Terminal Tower, are architects.

O., Dayton—Riverdale Realty Co., R. L. Pine, Secy., Harries Bldg., plans the construction of a 10 story office building on West Monument Ave. Estimated cost $1,500,000. Geyer & Neuffer, Ludlow Arcade, are architects.

O., Wilberforce — Wilberforce University, awarded contract for the construction of a 79 x 82 ft. power house to McCurran Bros., Xenia. Estimated cost $51,776.

Okla., Enid—Youngblood Hotel Co., will soon award contract for a 14 story hotel including steam heating, ventilation and refrigeration systems, boilers, pumps, elevators, etc., on Square St. Estimated cost $800,000. R. W. Shaw, is architect.

Pa., Bethlehem—Lehigh & New England Terminal Co., plans the construction of an ice manufacturing plant. Estimated cost $65,000.

Pa., Middletown—Odd Fellows' Home, awarded contract for the construction of a power house to J. W. Promraning, Harrisburg. Estimated total cost $60,000.

Pa., Philadelphia—Dept. of City Transit, C. E. Meyers, Dir., City Hall Annex, awarded contract for the construction of sub-station No. 7 for Broad St. Subway, Juniper and Pine Sts, to Kaber Construction Co., 1616 Thompson St., Estimated cost $132,369.

Pa., Philadelphia—Owner, c/o C. E. Oelschlager, 1615 Walnut St., Archt., awarded contract for the construction of an 18 story apartment building at 26th and Chestnut Sts. to Graham-Chambley Co., 3649 Filbert St. Estimated cost $1,300,000.

Texas—Magnolia Gas Products Co., 506 South Medina St., San Antonio, plans the construction of three compressor stations, one at the W. W. White Rd. near San Antonio, another near Beeville and a third near Mathis. Private plans.

Tex., Corpus Christi—H. C. Sherman, et al, awarded contract for the construction of a 15 story office building to Wood & Sherman Construction Co. Estimated cost $500,000. Steam heating and refrigeration systems, boilers, elevators, etc. will be installed.

Tex., Waxahachie—Pure Ice Co., c/o W. P. Bender awarded contract for a 25 ton ice plant to O. B. Bennett, Waxahachie. Estimated cost $35,000.

Va., Shenandoah—Massanutten Power Co., operated by Page Power Co., Luray, plans extensions and improvements to steam operated electric power plant. Estimated cost $100,000. W. C. Whitner & Co. Inc., Electric Bldg., are engineers.

Wash., Centralia—City will receive bids until July 2 for the construction of a dam, 8 ft. high and 600 ft. long to divert water to a canal 9.6 mi. long near Yelm in connection with $1,000,000 hydro-electric project on Nisqually River.

Wash., Seattle—V. W. Voorhees, Lloyd Bldg., Archt., will receive bids until June 15, for a 15 story office building including automatic elevators, etc. at Third and Union Sts. for Union Leasehold Co., Lloyd Bldg. Estimated cost $1,000,000.

Wis., Milwaukee—Dish & Bauer, 208 3rd St., Archts., is receiving bids for a 14 story hotel including steam heating system, elevators, etc. on Second St. for Freuber Hotel Co., 216 West Water St. Estimated cost $2,000,000.

Wis., Milwaukee—Lindl-Schuette Inc., 429 Broadway, Archt., will receive bids until June 17 for an 8 story apartment building including steam heating and refrigeration systems, elevators, etc. on 12th St. for Grossman & Cohen Co., 105 Wells St.

Ont., Ottawa—Chats Falls Power Co., Montreal, Que., plans the construction of a hydro-electric power development on the Ottawa River at Chats Falls, near here. Estimated cost $2,500,000.

Ont., Toronto—Bell Telephone C. of Canada, 76 Adelaide St. W., will soon award contract for a 12 story telephone exchange building including steam heating system, electric elevators, etc. Estimated cost $1,000,000. Chapman & Oxley, Sterling Tower, are architects.

Ont., Toronto—Canadian Pacific Railway Co., Windsor Station, Montreal, Que., plans the construction of addition to Royal York hotel including steam heating system, elevators, etc. Estimated cost $500,000. Sproatt & Ralph, 1162 Bay St., Toronto and Ross & McDonald, 1 Belmont St., Montreal, Que., are associate architects.

Ont., Windsor—Merlo Merlo & Ray, Sandwich St., Ford City, is having plans prepared for the construction of an 18 story office building including steam heating system, etc. on Ouellette Ave. here. Estimated cost $1,500,000. Pennington & Boyde, 1002 Security Bldg., are architects.

Ont., Windsor—Prince Edward Hotel, M. W. Gilbert, Mgr., will receive bids about June 1, for a 10 story addition to hotel including steam heating system, etc. also 4 story addition to present building on Ouellette Ave. Estimated cost $650,000. Pennington & Boyde, 1002 Security Bldg., are architects.

Alaska, Eyak, Cordova—Bureau of Yards & Docks, Navy Dept., Washington, D. C., awarded contract for a hydro-electric plant, oil burners, etc. at Naval Radio Station here to W. T. Butler, 527 Central Bldg., Seattle, Wash. Estimated cost $31,500.

Equipment Wanted

Air Compressors, Pump, Etc.—City of High Point, N. C., air compressors pump etc. for proposed waterworks improvements.

Boilers — Bd. Education, Cleveland, O., will receive bids until June 17 for furnishing and setting new steel boilers at Denison school.

Engine—City of Russell, Kan., plans to purchase a 500 or 600 hp. Diesel engine for electric light plant. Estimated cost $35,000.

Generator—City of Westmount, Que., plans to purchase a 2,000 kw. steam turbine generator. Estimated cost, $65,000.

Motors—A. F. Wall, Paul Kruger St. and 7th Ave., Montreal, Que., is in the market for one 75 and one 25 hp. electric motors.

Pump and Motor—City of Hinton, Okla., is in the market for a deep well pump and motor.

Pump and Motor—City of Merriman, Neb., E. Gardner, Clk., is receiving new bids for a 60 g.p.m. pump and motor, etc. for proposed waterworks improvements. Estimated cost $18,225.

Pump and Motors—City of Belfield, N. D., W. L. Richter, Aud., will receive bids until June 27 for two deep well turbine pumps and motors, etc. for proposed waterworks improvements. Estimated cost $35,000.

Water Heater — A. & Mec. College of Texas, College Station, Tex., is receiving bids for a 42 in. closed feed water heater for shower heads supply equipped with low and high pressure element for 160 lb. steam pressure.

Industrial Projects

Calif., Long Beach—GLASS FACTORY—Long Beach Glass Co., plans the construction of a factory to include two blast furnaces on Montana Ranch. Estimated cost $500,000.

Calif., Los Angeles—AVIATION PLANT—El Travia Industrial Terminal Corp., 6600 Lexington Ave., awarded contract for a 12 story, 150 x 980 ft. plant on 33rd St. to Sumner-Sollitt Co., 810 West 6th St. Estimated cost $5,000,000.

Calif., Los Angeles—PAPER BOX FACTORY—Standard Paper Box Co., 3837 Moneta Ave., is having plans prepared for a 7 story, 50 x 145 ft. factory. E. H. Cline, Petroleum Securities Bldg., is engineer.

Calif., Santa Ana — GLASS FACTORY — Pittsburgh Plate Glass Co., Grant Bldg., Pittsburgh, Pa., is having plans prepared for a glass plant here. Estimated cost $4,000,000. Private plans.

Ill., Barrington — TEA FACTORY — Jewell Tea Co., 5 North Wabash Ave., Chicago, will soon award contract for a 2 and 5 story factory here. Estimated cost $1,000,000. Holabird & Root, 333 North Michigan Ave., Chicago, are architects.

Ill., Bensenville—MOTOR FACTORY—Willis Motor Corp., First Ave. and Main St., Maywood, will soon receive bids for a 1 story and 2 story 60 x 1600 and 90 x 90 ft. factory here. Estimated cost $1,200,000. G. E. Larson, 5154 North Clark St., Chicago, is architect.

Ill., Rockford—AUTOMOBILE HEATER FACTORY—Sall Bros. Inc., awarded contract for a 1 and 2 story, 66 x 145 ft. plant for the manufacture of castings, automobile heaters, etc. on Kishwaukee St. to Linden & Son, 1110 10th St. Estimated cost $100,000.

Ia., Cedar Rapids—PACKING PLANT—T. M. Sinclair & Co., Ltd., 3rd St. and 16th Ave., awarded contract for the construction of a plant to include beef house, loading platform and box factory to O. F. Paulson, 405 Granby Bldg. Estimated cost $200,000.

Mich., Flint—MOTOR FACTORY AND SERVICE BUILDING—Chevrolet Motor Co., is having plans prepared for a 1 story, 240 x 375 ft. factory and service building. Estimated cost $500,000. Wright & Nice, 220 Dort Bldg., are architects.

Minn., Minneapolis—REGULATOR FACTORY ADDITION — Minneapolis-Honeywell Regulator Co., H. W. Sweatt, V. Pres. and Gen. Mgr., 4th Ave. S. between 27th and 28th Sts., awarded contract for a 6 story addition to factory to Pike & Cook, 416 South 5th St. Estimated cost $200,000.

Miss., Gulfport—SPINNING MILL—Walcott & Campbell Spinning Co., Inc., awarded contract for a 2 story, 107 x 412 ft. mill including picker building, warehouse, loading platforms, etc. to Wagar & Co., Norris Bldg., Atlanta, Ga. Estimated cost $175,000.

N. J., Elizabeth—ROLLING MILL—National Electric Products Corp., Bayway, awarded contract for a 1 story, 95 x 360 ft. rolling mill at Bayway and South Front St., to United Engineering & Construction Co., North Broad St., Philadelphia, Pa. Estimated cost $100,000.

N. J., Newark—PLATINUM FACTORY—American Platinum Works, 231 New Jersey Railroad Ave., will receive bids about June 14 for a 4 and 5 story addition to factory at River St. and New Jersey Railroad Ave. Estimated cost $50,000. F. A. Phelps, 21 Fulton St., is architect.

N. J., Paterson—AIRPLANE FACTORY—Wright Aeronautical Corp., 238 Lewis St., is having plans prepared for a 1 story addition to factory on Madison Ave. Estimated cost $750,000. Private plans.

O., Cleveland—CHEMICAL FACTORY—McGean Chemical Co., 1822 B. F. Keith Bldg., awarded contract for the construction of a group of buildings for chemical factory at 2910 Harvard Ave. to Craig-Curtis Co., 4614 Prospect Ave. Estimated cost $250,000.

Pa., Wilmerding—HIGH TESTING BUILDING—Western Electric & Mfg. Co., East Pittsburgh, awarded contract for a 1 story, 63 x 176 ft. high testing building here to D. T. Riffle 1006 Forbes St., Pittsburgh. Estimated cost $100,000.

S. C., Spartanburg—BLEACHERY—Fairforest Bleachery Co., awarded contract for a 2 story, 210 x 415 ft. plant to Fiske-Carter Construction Co., Greenville. Estimated cost $1,000,000.

Ont., Guelph—FOUNDRY—Guelph Stove Co., awarded steel contract for addition to foundry. Estimated cost $250,000.

Ont., Stratford—FURNITUR FACTORY—Kroehler Mfg. Co., F. W. Trebell, Mgr., is having plans prepared for a 3 story, 65 x 100 and 45 x 100 ft. addition to factory including two new kilns, etc. Estimated cost $100,000. Private plans. Woodworking equipment, etc. will be required; owner also plans a new 3 story furniture assembly plant at Montreal, Que.

Que., Montreal—FACTORY AND POWER HOUSE—Simmons Ltd., 400 St. Ambroise St. awarded contract for an 80 x 120 ft. factory and 52 x 150 ft. power house to Anglin-Norcross Ltd., 65 Victoria St. Estimated cost $145,000.

PRICES - MATERIALS - SUPPLIES

Electrical prices on following page are to the power plant by jobbers in the larger buying centers east of the Mississippi. Elsewhere the prices will be modified by increased freight charges and by local conditions.

SINCE LAST MONTH

TWO major changes occurred during May, in prices of electrical supplies listed here, one an advance and the other a decline. Discounts were reduced 5 to 6 points on refills (fuses) in unbroken cartons and ten-carton lots, unbroken. Armored cable, on the other hand, declined $1 per M ft. ($30) for No. 14 solid, two conduit, net. Three conduit, dropped $5 per M ft. ($40) in the last month. Linseed oil is up 0.3c. per lb. (11.2c.) at New York and 0.1c. (11.4c.) at Chicago. Round head rivets, ½-in., are $4 per 100 lb. at Chicago, compared with $3.80, a month ago.

POWER-PLANT SUPPLIES

HOSE—Quotations at New York warehouses:

	Fire Protection	50-Ft. Lengths
Underwriters' 2½-in., coupled, single jacket	(net)	60c. per ft.
Common, 2½-in., cotton, rubber-lined	80c. per ft. list, less	50%

Air—Best grade

¾-in., per ft.	3-ply	$0.30	4 ply	$0.36

Steam—Discounts from List

First grade	40%	Second grade	45%	Third grade	50–10%

RUBBER BELTING—List price 6-in., 6 ply, $1.83 per lin.ft. The following discounts from list apply to rubber transmission belting:

Best grade	50%	Second grade	60%

LEATHER BELTING—List price, 24c. per lin.ft., per inch of width, for single ply, at New York warehouses:

Grade	Discount from list
Medium	30–10%
Heavy	30– 5%

RAWHIDE LACING—For cut, best grade, 30–5%; 2nd grade, 45–5%. For laces in sides, best, 57c. per sq.ft.; 2nd, 52c., net. Semi-tanned, cut, 30–5%.

PACKING—Prices per pound at New York warehouses:

Rubber and duck for low-pressure steam, ¼ in.	$0.90
Asbestos for high-pressure steam, ¼ in.	1.75
Duck and rubber for piston packing	.90
Flax, regular	1.15
Flax, waterproofed	1.70
Compressed asbestos sheet	.85
Wire insertion asbestos sheet	1.20
Rubber sheet	.45
Rubber sheet, wire insertion	.75
Rubber sheet, duck insertion	.55
Asbestos packing, twisted or braided and graphited, for valve stems and stuffing boxes	1.40
Asbestos wick, ½- and 1-lb. balls	.50

PIPE AND BOILER COVERING—Discounts from list at New York warehouses are as follows:

85% magnesia, high pressure		50%
Asbestos, air cell, for low-pressure heating and return lines	4-ply	70%
	3-ply	72%
	2-ply	74%

PORTLAND CEMENT—New York, $2.25 per bbl., without bags, delivered by truck to site of job. Bag charge, 40c. per bbl.

STRUCTURAL STEEL—New York delivered price, beams and channels, 3 to 15-in.; angles, 3 to 6-in., ¼-in. thick; tees, 3-in. and larger; and plates, ¼-in. thick and heavier; all $3.30 per 100 lb. in lots up to 3,999 lb.

COTTON WASTE—The following prices are in cents per lb., at warehouse:

	New York	Cleveland	Chicago
White	10.00@13.50	16.00	15.00
Colored	9.00@13.00	12.00	12.00

WIPING CLOTHS—Prices per pound in lots of about 600 lb., for washed white wipers, as follows:

Chicago (100 lb. bales)	$0.16
New York (100 lb. bales)	.16
Cleveland (per thousand)	38.00

LINSEED OIL—These prices are for raw oil in barrels, f.o.b., in 1 to 4 bbl. lots:

	New York	Cleveland	Chicago
Per pound	$0.112	$0.11	$0.114

WHITE AND RED LEAD—Per 100-lb. keg, base price, f.o.b., New York:

	Dry	In Oil
Red	$13.75	$15.25
White	13.75	13.75

RIVETS—The following quotations are allowed for fair-sized orders from warehouse:

Tank rivets, ¾-in. diameter and smaller, list (Apr. 1, 1927) less 60% in full packages, for immediate delivery from warehouse stocks in New York and vicinity.

Structural rivets, ½-in., round head, per 100 lb.:

New York	$4.50*
Chicago	4.00
Pittsburgh mill	3.10

*Price is for full packages; broken package lots are $6.00 net, delivered.

REFRACTORIES—Prices in car-loads, f.o.b., plant:

Chrome brick, eastern shipping points	per net ton	$45.00
Chrome cement, 40@50% Cr_2O_3, in bulk	per net ton	22@25
Chrome cement, 40@50% Cr_2O_3, in sacks	per net ton	26@29
Magnesite brick, 9-in. straights	per net ton	65.00
Magnesite brick, 9-in. arches, wedges and keys	per net ton	71.50
Magnesite brick, soaps and splits	per net ton	91.00
Silica brick, Mt. Union, Pa.	per M	43.00
Clay brick, 1st quality, 9 in. shapes, Pennsylvania	per M	43@46
Clay brick, 1st quality, 9 in. shapes, Ohio	per M	43@46
Clay brick, 1st quality, 9 in. shapes, Kentucky	per M	43@46
Clay brick, 1st quality, 9 in. shapes, Maryland	per M	43@46
Clay brick, 2nd quality, 9 in. shapes, Pennsylvania	per M	35@38
Clay brick, 2nd quality, 9 in. shapes, Ohio	per M	35@38
Clay brick, 2nd quality, 9 in. shapes, Kentucky	per M	35@38
Clay brick, 2nd quality, 9 in. shapes, Maryland	per M	35@38
Chrome ore crude, 40@50%	per net ton	18.00@22.50

BABBITT METAL—Delivered, New York, cents per lb.:

Genuine, highest grade	61.00
Commercial genuine, intermediate grade	45.00
Anti-friction metal, general service	31.50
No. 4 babbitt (f.o.b.)	12.00

COLD DRAWN STEEL—Shafting and screw stock, warehouse prices per 100 lb., base, are as follows:

	New York	Cleveland	Chicago
Round or hexagon	$3.50	$3.65	$3.60
Flat or square	4.00	4.15	4.10

BOILER FITTINGS—F.o.b. warehouse, Jersey City, N. J., discounts from list:

Copper ferrules	70%
Boiler flanges	65–5%
Boiler stay bolts	60%
Boiler patch bolts	20%
Boiler fitting-up bolts	45%
Pressed steel boiler lugs	10%

WROUGHT PIPE—The following basing discounts from list are for large mill lots at Pittsburgh mill:

BUTT WELD

Inches	Steel Black	Steel Galv.	Inches	Iron Black	Iron Galv.
1 to 3	62%	50½%	⅛ and 1¼	31%	15%

LAP WELD

2	55%	43½%	2	23%	9%
2½ to 6	59%	47½%	2½ to 3½	28%	13%
7 and 8	56%	43½%	4 to 6	30%	17%
9 and 10	54%	41½%	7 and 8	29%	16%
11 and 12	53%	40½%	9 to 12	26%	11%

BUTT WELD, EXTRA STRONG, PLAIN ENDS

1 to 1½	60%	49½%	1 to 2	34%	18%
2 and 3	61%	50½%			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	53%	42½%	2	29%	13%
2½ to 4	57%	46½%	2½ to 4	34%	20%
4½ to 6	56%	45½%	4½ to 6	33%	19%
7 and 8	52%	39½%	7 and 8	31%	17%
9 and 11	45%	32½%	9 to 12	21%	8%
11 and 12	44%	31½%			

BOILER TUBES—Following are net prices per 100 ft. at New York warehouses on tubes manufactured according to specifications of the American Society of Mechanical Engineers:

Size	Lapweld Steel	C. C. Iron	Seamless Steel
1	.....	.....	$17.07
1¼	.....	.....	19.20
1½	.....	$38.00	17.92
1¾	.....	28.50	20.48
2	$17.33	25.00	20.24
2¼	19.84	28.25	23.00
2½	21.60	34.00	26.03
3	25.50	42.50	27.04
3½	30.25	49.50	30.67
3½	31.50	52.75	33.33
4	38.03	67.00	40.11

These prices are net, per 100 ft., based on stock lengths. If cut to special lengths, billing will be based on the entire stock lengths.

In addition to the above, standard cutting charges are as follows:

2 in. and smaller 5c. per cut. 3 in..... 9c. per cut.
2½ and 2¾ in.... 6c. per cut. 3½ to 4 in.... 10c. per cut.

ELECTRICAL SUPPLIES

ARMORED CABLE—Price per 1,000 ft.—5 per cent. 10 days.

B. & S. Size	Two Cond. M Ft.	Three Cond. M Ft.	Two Cond. Lead M Ft.	Three Cond. Lead M Ft.
No. 14 solid	$30.00 (net)	$40.00 (net)	$180.00	$220.00
No. 12 solid	136.00	180.00	225.00	275.00
No. 10 solid	185.00	235.00	275.00	325.00
No. 8 stranded	305.00	375.00	420.00	500.00
No. 6 stranded	440.00	530.00	615.00	.....

From the above lists discounts are:

		Lead Covered
Less than coil lots	50%	30%
Coils to 1,000 ft.	60%	35%
1,000 to 5,000 ft.	65%	38%
5,000 ft. and over	67%	40%

CONDUIT—Price per 1,000 ft.: **ELBOWS AND COUPLINGS**, per 100 pieces, extra f.o.b. New York warehouse. Discount of 5 per cent. for payment in 10 days. No delivery charges, regardless of quantity.

Size In.	Conduit Black Per M	Conduit Galvanized Per M	Elbows Black Per C	Elbows Galvanized Per C	Couplings Black Per C	Couplings Galvanized Per C
¼	$56.50	$61.34	$7.76	$8.83	$4.52	$4.92
½	72.07	78.63	10.21	11.63	6.46	7.03
1	103.31	113.00	15.10	17.21	8.39	9.13
1¼	139.77	152.88	20.51	23.07	11.78	12.75
1½	167.12	182.79	27.34	30.76	14.56	15.75
2	224.85	245.94	50.13	56.40	19.41	21.01
2½	355.50	388.85	82.03	92.28	27.73	30.01
3	464.88	508.50	218.74	246.10	41.59	45.01
3½	585.30	637.74	483.04	543.46	55.46	60.02
4	714.17	776.30	558.23	628.06	69.32	75.02

CONDUIT BODIES AND FITTINGS—Black or galvanized.

	Less than $10 list	$10 list to $100	$100 list and over
Standard package	10%	20%	28%
Less than standard package	5%	10%	20%

CUT-OUTS—Following are net prices, each, in standard-package quantities:

CUT-OUTS, PLUG, SOLID, NEUTRAL OR 2-FUSE

S. P. M. L.	$0.12	D. P. D. B.	$0.31
D. P. M. L.	.16	T. P. S. B.	.35
T. P. M. L.	.27	T. P. D. B.	.47
D. P. S. B.	.16		

CUT-OUTS, N. E. C. FUSE, SOLID, NEUTRAL OR 2-FUSE

	0-30 Amp.	31-60 Amp.	60-100 Amp.
D. P. M. L.	$0.27	$0.70	$1.75
T. P. M. L.	.40	1.00	2.30
D. P. S. B.	.35	.87	.....
T. P. S. B.	.67	1.50	.....
D. P. D. B.	.65	1.75	.....
T. P. D. B.	1.12	3.00	.....
T. P. to D. P. D. B.	.75	2.10	.....

FLEXIBLE CORD—Price per 1,000 ft. in coils of 250 ft.:

No. 18 cotton reinforced heavy		$21.50
No. 16 cotton reinforced heavy		25.00
No. 18 cotton reinforced light		15.50
No. 16 cotton reinforced light		22.00
No. 18 cotton Canvasite cord		17.00
No. 16 cotton Canvasite cord		27.00
No. 16 super service cord or similar (2 wire) in 1,000 ft.	$70.80	*76.70
No. 14 super service cord or similar (2 wire) in 1,000 ft.	106.20	*115.05

*Less than 1,000 ft.

NATIONAL ELECTRIC CODE FUSES, NON-REFILLABLE—

250-Volt	Std. Pkg.	List	600-Volt	Std. Pkg.	List
3-amp. to 30 amp.	100	$0.15	3-amp. to 30-amp.	100	$0.30
35-amp. to 60-amp.	100	.30	35-amp. to 60-amp.	100	.60
61-amp. to 100 amp.	50	.90	65-amp. to 100-amp.	50	1.50
101-amp. to 200-amp.	25	2.00	110-amp. to 200-amp.	25	2.50
201-amp. to 400-amp.	25	3.60	225-amp. to 400-amp.	25	5.50
401-amp. to 600-amp.	10	5.50	450-amp. to 600-amp.	10	8.00

Discount: Less than one-fifth standard package, 60%; one-fifth to standard package, 65%; standard package, 70%.

RENEWABLE FUSES—List price each:

Sizes	250-Volt List-Price	600-Volt List-Price	Std. Pkg. Quantity	Carton Quantity
1 to 30-amp.	$0.50	$1.10	100	10
35 to 60-amp.	1.00	1.25	100	10
65 to 100-amp.	2.00	3.00	50	5
110 to 200-amp.	4.00	5.00	25	5
225 to 400-amp.	7.50	11.00	25	1
450 to 600-amp.	11.00	16.00	10	1

REFILLS—

1 to 30-amp.	$0.03 ea.	$0.05	100	100
35 to 60-amp.	.05 ea.	.06	100	100
65 to 100-amp.	.10 ea.	.10	50	50
110 to 200-amp.	.15 ea.	.15	25	50
225 to 400-amp.	.30 ea.	.30	25	25
450 to 600-amp.	.60 ea.	.60	10	10

Discount Without Contract—Fuses:

Broken cartons	Net list
Unbroken cartons	17%
Ten unbroken cartons	34%

Discount Without Contract—Renewals:

Broken cartons	Net list
Unbroken cartons	17%
Ten unbroken cartons	34%

Discount With Contract—Fuses:

Broken cartons	5%
Unbroken cartons	20%
Ten unbroken cartons	36%

Discount With Contract—Renewals:

Broken cartons	Net list
Ten unbroken cartons	36%

Carton quantities may be combined to obtain maximum discounts.

FUSE PLUGS, MICA CAP—

0-30 ampere, standard package (500)	$2.80
0-30 ampere, less than standard package	3.10

LAMPS—Below are present quotations in less than standard package quantities on Mazda standard, A type bulbs:

100—130 Volt General Watts	Type	Price Each	200—260 Volt Special Watts	Type	Price Each
15	A 17	$0.20	25	A 19	$0.25
25	A 19	.20	50	A 21	.25
40	A 21	.20	100	A 23	.45
50	A 21	.20	....	....	....
60	A 21	.20	....	....	....
100	A 23	.35	....	....	....

Standard pkg. quantities are subject to discount of 10% from list. Annual contracts ranging from $75 to $300,000 net, allow a discount of 15 to 40% from list.

PLUGS, ATTACHMENT—

	Each
Porcelain, separable, attachment plug	$0.18
Composition, 2-piece, attachment plug	.27
Swivel attachment plug	.12
Small size, 2-piece plug, composition	.07

RUBBER-COVERED COPPER WIRE—Per 1000 ft. f. o. b. New York:

No.	Solid Single Braid	Solid Double Braid	Stranded, Double Braid	Solid Duplex
14	$7.20	$9.90	$12.30	$20.50
12	10.90	12.69	15.50	27.00
10	14.85	16.85	20.40	36.15
8	22.05	24.80	27.10	51.00
6	.....	.....	39.50	.....
4	.....	.....	57.00	.....
2	.....	.....	79.50	.....
1	.....	.....	107.00	.....
0	.....	.....	132.00	.....
00	.....	.....	158.00	.....
000	.....	.....	193.00	.....
0000	.....	.....	235.00	.....

SOCKETS, BRASS SHELL—Price each, net:

	¼ In. or Pendant Cap Key	¼ In. or Pendant Cap Keyless	¼ In. or Pendant Cap Pull	½ In. Cap Key	½ In. Cap Keyless	½ In. Cap Pull
Standard package	$0.12	$0.10	$0.16	$0.16½	$0.14	$0.20
Unbroken carton	.14	.12	.18	.18	.16	.21
Broken carton	.16	.14	.20	.20	.18	.24

WIRING SUPPLIES—

Friction tape, ¾ in., less than 100 lb., 31c. per lb.	100 lb. lots	29c per lb.
Rubber tape, ¾ in., less than 100 lb., 33c. per lb.	100 lb. lots	31c per lb.
Wire solder, less than 100 lb., 33c. per lb.	100 lb. lots	31c. per lb.
Soldering paste, 2 oz. cans		$1.10 doz.

ENCLOSED SWITCHES, KNIFE—Safety type, externally operated, 250 d.c or a.c., N.E.C.

TYPE "C" FUSED BOTTOM

Size, Amp.	Double Pole, Each	Three Pole, Each	Four Pole Each
30	$4.50	$6.00	$7.25
60	7.50	8.25	10.50
100	10.50	13.00	22.50
200	16.00	20.00	36.00

Discounts:

Less than $25.00 list value	30%
$25.00 to $50.00 list value	35%
$50.00 list value or over	40%